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GROUNDWATER INVESTIGATION WORK PLAN

Shieldalloy Metallurgical Corporation Superfund Site Operable Unit 3 Perchlorates

Prepared for

Shieldalloy Metallurgical Corporation
35 South West Boulevard
Newfield, New Jersey 08344

Prepared by

Geosyntec Consultants, Inc.
7 Graphics Drive, Suite 106
Ewing, New Jersey 08628

Project JR0241

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Project Number: JR0241

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ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	contaminant of concern
CPS	calcium polysulfide
DQO	Data Quality Objective
DSRA	Development and Screening of Response Alternatives
EVO	emulsified vegetable oil
FSP	Field Sampling Plan
ft bgs	feet below ground surface
gpm	gallons per minute
GIWP	Groundwater Investigation Work Plan
GWQS	New Jersey Ground Water Quality Standard
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HHRA	Human Health Based Risk Assessment
IHAL	Interim Health Advisory Level
MNA	monitored natural attenuation
NJDEP	New Jersey Department of Environmental Protection
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
ppb	parts per billion
QA/QC	Quality Assurance/Quality Control
RSL	Regional Screening Level
SLERA	Screening-Level Ecological Risk Assessment
SMC	Shieldalloy Metallurgical Corporation
TCE	trichloroethene
TRC	TRC Environmental Corporation
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

On behalf of Shieldalloy Metallurgical Corporation (SMC), Geosyntec Consultants, Inc. has prepared this Groundwater Investigation Work Plan (GIWP) to address Operable Unit (OU) 3 Perchlorates at the Shieldalloy Corporation Superfund Site in Newfield, New Jersey. OU3 is defined by USEPA as perchlorate contamination in soil, groundwater, and surface water and sediment in Site-associated bodies of water. This GIWP was prepared in accordance with USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

1.1 Scope

Attachment A includes previously collected data that shows perchlorate concentrations in Site soil, surface water and sediment are below respective USEPA Residential Regional Screening Levels (RSLs). Consequently, the GIWP focuses further investigation on perchlorate contamination of groundwater. The most recent round of groundwater sampling for perchlorate at the Site was in 2011. Though the perchlorate plume was well-defined at that time, more current groundwater sampling is needed to assess whether conditions have changed.

The aim of this GIWP is to:

- Investigate the current extent of the perchlorate plume;
- Assess the geochemical characteristics of the aquifer and the potential influence of these characteristics on potential remedies for perchlorate, including monitored natural attenuation (MNA);
- Evaluate the USEPA concern that irrigation wells upgradient of the Site may be pulling groundwater from the Site upgradient (TRC, 2016);
- Evaluate potential background sources of perchlorate; and
- Provide current data that will inform later remedy selection documents, including the Development and Screening of Response Alternatives (DSRA) and Feasibility Study.

1.2 Site Location and History

The Site is comprised of 67.7 acres previously devoted to manufacturing (Main Facility) and 19.8 acres of farmland (Farm Parcel) located about 2,000 feet apart. The Site is mainly located in Newfield, Gloucester County, New Jersey, though portions fall within Vineland, Cumberland County, New Jersey municipal bounds. The Site address is 35 South West Boulevard, Newfield. Figure 1 shows the Site location.

Specialty glass manufacturing began at the Main Facility in 1924. SMC purchased the facility in the early 1950s and, from 1955 to approximately 2007, manufactured items such as specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals and optical surfacing products. Current and historical use of the Farm Parcel remains agricultural.

According to information provided by SMC staff generally familiar with past operational practices, potassium perchlorate was used as an oxidizer in the on-Site furnace to increase temperature and enhance furnace performance. The furnace was located within the footprint of former Building D102(A), attached to but isolated from Building D112. Both buildings have since been demolished. Building D102(A) was characterized by an earthen floor (although the area surrounding the building is currently and was historically paved). According to historical purchase order records, SMC purchased approximately 400,000 pounds of potassium perchlorate from 1974 to 1992 for this operational activity. Potassium perchlorate was typically packaged and shipped to the Site in 110-, 250-, and 350-pound, plastic-lined steel drums. Prior to being used in the furnace, this product was reportedly stored on Site in a former small metal outbuilding (referred to as the Former Chemical Storage Building), east of former Building D102(A) and near the unpaved road forming the northwest boundary of the storage yard slag piles. This Former Chemical Storage Building was characterized by a concrete interior floor and berm around the building's perimeter. Based on this reported information, the storage and usage of perchlorate on Site were limited to these areas, which are identified in Figure 2. Since perchlorate was completely destroyed in the heating process by reacting with aluminum to form chlorides, there was no general release from this process. Only incidentally spilled material or small amounts of incompletely reacted material were released into the environment. One possible disposition for incompletely reacted/residual perchlorate was release to a former lagoon area, also shown in Figure 2 (TRC, 2016).

1.3 Environmental Investigations and Remediation

The Site has an extensive history of soil, groundwater, sediment and surface water investigation. Environmental investigations at SMC began in 1972 to determine whether there was a relationship between the Site's operations and elevated concentrations of metals in the municipal water supply. Remedial activities that may be relevant to perchlorate investigation and remediation are summarized below (TRC, 2008) (USEPA, 2015):

- SMC installed an 80 gallons per minute (gpm) groundwater pump and treat system in 1979 to remediate chromium and trichloroethene (TCE). The groundwater was treated using ion exchange.
- SMC installed additional wells and increased extraction to 400 gpm to control off-Site migration of hexavalent chromium in 1988 and 1989.
- SMC expanded the treatment system to include an air stripper to address TCE.
- SMC switched from ion exchange to electrochemical precipitation in 1991 to address chromium concentrations in the extracted groundwater.
- SMC characterized, treated and closed nine wastewater treatment lagoons from 1994 to 1997.
- Investigation of plume geometry of various contaminants of concern (COCs) through vertical profiling and monitoring well installation is completed from 2002 to 2011.
- In situ remediation treatability studies began in 2010 after finding the current treatment systems were no longer efficiently treating Site COCs (concentration reduction had

become asymptotic). Calcium polysulfide (CPS) was identified as an effective reagent for treating chromium-impacted groundwater. Emulsified Vegetable Oil (EVO) was found to be an effective electron donor to promote microbial degradation of TCE.

- SMC installed a new ion exchange unit in the groundwater treatment plant in 2011.
- TRC conducted an Ecological Risk Assessment and a Human Health Risk Assessment for OU3 in 2013 and 2014, respectively.

Perchlorate impacts were initially assessed during monitoring events in 2004. Concentrations in soil, surface water and sediment were reported to be below respective USEPA Residential RSLs. Therefore, these media were not further evaluated. Perchlorate concentrations in groundwater were above the New Jersey Class II-A Ground Water Quality Standard (GWQS) of 5 parts per billion (ppb) (TRC, 2014) (NJDEP, 2018). Data obtained for all media are included in Attachment A to this document.

Periodic groundwater sampling was conducted until 2011, when the perchlorate plume was sufficiently defined to the USEPA Interim Health Advisory Level (IHAL) of 15 ppb. Isopleths developed from the 2011 data are provided in Attachment B and show perchlorate present at concentrations above the GWQS in the shallow, intermediate and deep aquifer zones, with the plume deepening and migrating in a southwesterly direction under the influence of advective groundwater transport and a downward hydraulic gradient (TRC, 2016).

1.4 Perchlorate in the Regional Environment

Moderate perchlorate concentrations in the deep aquifer zone in wells that are located upgradient of the Site's potential perchlorate source areas suggest that there may be a regional perchlorate contamination issue unrelated to Site activities (data provided in Attachment A). The regional presence of perchlorate may have resulted from the extensive agricultural land use within the area and the potential use of Chilean-mined fertilizers (of which perchlorate is a component) on the area farms. The documentation of the presence of perchlorate in lettuce crops in Newfield and Bridgeton and spinach crops in Vineland (U.S. Food and Drug Administration, 2005) and the historical use of irrigation wells in the area provide additional evidence of the potential for a regional groundwater perchlorate issue. In 2009, drinking water quality testing conducted by the City of Vineland (which obtains its drinking water from groundwater) included perchlorate as an analyte under the Unregulated Contaminant Monitoring Rule (City of Vineland, 2009). Perchlorate was reported at concentrations ranging from 5.18 to 6 ppb in drinking water supply samples, demonstrating the regional presence of perchlorate in the groundwater (TRC, 2016).

1.5 Site Geologic, Hydrogeologic, and Hydrologic Setting

1.5.1 Geology

Three unconsolidated sedimentary units underlie the Site. From shallowest to deepest they are:

- The Bridgeton Formation - consists of up to 28 feet of brown sand and is present in the eastern portion of the Site (TRC, 2011);

- The Cohansey Sand – is the primary aquifer of concern and is comprised of coarse sands and little silt in the upper 40 feet, with generally finer sand and some clay and silt lenses in the lower 60 to 80 feet. Discontinuous silt and clay up to 6 feet in thickness is found within the lower section of the formation. The Cohansey Sand is predominantly composed of quartz, and secondary minerals include aluminum oxides and iron-containing minerals (e.g. illite and pyrite) (TRC, 2015); and
- The Kirkwood Formation – the upper portion of this unit consists of a gray silt and clay layer and is generally encountered between 121 and 153 feet below ground surface (ft bgs).

Bedrock has not been encountered in previous Site investigations; it is estimated that the depth to bedrock beneath the Site is approximately 2,000 ft bgs (TRC, 2016).

1.5.2 Hydrogeology

The principal aquifer at the Site and surrounding area is the Cohansey Sand aquifer, which is approximately 130 feet thick. The upper portion of the Kirkwood Formation, consisting of silt and clay, functions as a confining unit by restricting the downward flow of groundwater. Groundwater flow direction in both the upper and lower Cohansey Sand is southwest toward an on-Site stream known as the Hudson Branch. Seasonal fluctuations in water table elevations are on the order of a few feet, and depth to groundwater has been measured at 4 to 27 ft bgs (TRC, 2016) (TRC, 2014).

1.6 Summary of Risk Assessments

In 2014, a Human Health Risk Assessment (HHRA) was conducted for OU3. The assessment rules out soil, surface water and sediment as posing a risk to human health. It reported that the following receptors were at risk of unacceptable perchlorate exposure through ingestion of groundwater, according to USEPA guidance:

- Future child resident exposed to on-Site shallow groundwater;
- Future adult and child resident exposed to off-Site deep groundwater;
- Future child resident exposed to Farm Parcel intermediate groundwater; and
- Future adult and child resident exposed to Farm Parcel deep groundwater.

Since the time the HHRA was completed, New Jersey has adopted a GWQS for perchlorate of 5 ppb for Class II-A groundwater. Class II-A groundwater is defined as groundwater that can be used as potable water or converted to potable water through treatment, mixing or other similar technique (NJDEP, 2018). Considering the institutional restrictions adopted for the Site, the fact that the only at-risk receptors are residents ingesting groundwater, and the fact that the GWQS was developed assuming the possibility of potable groundwater use, a remedial objective of 5 ppb will protect human receptors from unacceptable risk (TRC, 2014).

Additionally, a Screening-Level Ecological Risk Assessment (SLERA) was conducted in 2013. In accordance with USEPA guidance, the study utilized the maximum concentrations of perchlorate detected in Site soil, groundwater, surface water and sediment to conservatively

calculate the concentration of perchlorate that various communities of living organisms might be exposed to, as well as the maximum daily dose that might be consumed by multiple indicator species. The study concluded that even the highest perchlorate concentrations measured on Site are unlikely to pose a risk to terrestrial or aquatic communities (TRC, 2013).

2. CONCEPTUAL SITE MODEL

This section presents an overview of the Conceptual Site Model (CSM) for OU3. A CSM is a representation of the physical, chemical, and biological processes that govern the transport of COCs from source(s) to receptor(s) within the system. The CSM provides a comprehensive current understanding of the sources of COCs found in groundwater at OU3, potential pathways for migration of the COCs, and potential receptors of exposure to the COCs in OU3.

Perchlorate is the only COC at OU3. As discussed in Section 1.2, potassium perchlorate was used in the furnace located in former Building D102(A) as a catalyst. Unreacted slag from this process was disposed of in the former lagoon and slag piles, which were possible source areas for perchlorate.

The Site lies on the Bridgeton Formation (present in the eastern portion of the Site) and Cohansey Sand, which consist of sand and some silt. Groundwater is encountered at 4 to 27 ft bgs. Groundwater flow direction in both the upper and lower Cohansey Sand is southwest toward the Hudson Branch. Downward flow is restricted by the upper Kirkwood Formation which is encountered between 121 and 153 ft bgs. Monitoring wells are screened across the shallow, intermediate and deep zones of the aquifer to fully evaluate perchlorate concentrations.

Sampling was conducted by TRC from 2006 through 2011 to assess the distribution of perchlorate both on-Site and off-Site. Ten vertical profile borings (VP-1, VP-2, VP-3, VP-4, VP-10, VP-13, VP-13A, VP-14, VP-15, and VP-15A) were advanced and sampled to the southwest of the Site to determine the off-Site lateral and vertical extent of perchlorate. Based upon the results of this sampling, seven permanent monitoring wells (SC30D, SC32D, SC33D, SC34D, SC35D, SC36D, and SC40D) were constructed for long-term monitoring at the furthest extent of the perchlorate plume in the south, southwest, and northwest directions. Relevant boring logs, vertical profiling logs, and well construction diagrams are included in Attachment B.

Historic data, provided in Attachment A, show perchlorate concentrations in the shallow, intermediate, and deep aquifers at concentrations up to 90.5 ug/L, 20.9 ug/L, and 152 ug/L, respectively. Isopleth maps and vertical profile cross sections (Appendix A) created from historic sampling results show the highest perchlorate concentrations located beneath the Site and at the center of the plume in the deep zone approximately half a mile southwest of the Site. The groundwater sampling results through 2011 showed the perchlorate descended from source areas at the Site to the deep zone and then migrated to the southwest in the downgradient direction. Nearby irrigation pumping wells may have influenced the local groundwater flow patterns in the vicinity of the plume.

The applicable standard for perchlorate in groundwater is the GWQS of 5 ppb. This endpoint will be protective of human receptors who may ingest groundwater on Site and off Site.

3. PROJECT AND DATA QUALITY OBJECTIVES

The Data Quality Objective (DQO) process is a systematic planning tool that was designed to clarify the objectives of data collection and maximize efficiency during the data collection process. The DQO process is used to establish performance or acceptance criteria, which is the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. There are seven steps to the DQO process as outlined in EPA/240/B-06-001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006).

Step 1. State the Problem – This step defines the issues to be addressed in the RI/FS. Previous investigations at the Site have identified perchlorate in groundwater at levels above the GWQS. Eight years have elapsed since perchlorate was last investigated and it is necessary to characterize how the plume has changed to help USEPA select a remedy that will be protective of human health and meet the clean-up standards specified in CERCLA.

Step 2. Identify the Goal of the Study – This step identifies the question that the project will attempt to resolve and the actions which will be taken. As presented in Section 1.1, the goal of the OU3 GIWP is to investigate the current extent of the perchlorate plume, determine if the OU1 and OU2 remedies have influenced the perchlorate plume, assess the on-Site and off-Site geochemical characteristics, evaluate the USEPA concern that irrigation wells upgradient of the Site may be pulling groundwater from the Site upgradient.

Step 3. Identify Information Inputs – This step involves evaluation of existing data, identification of data gaps, and identification of new data needs. Shieldalloy has submitted several documents summarizing the previous investigations, findings of the usability assessment conducted for the data collected in these investigations, and the associated data in electronic format to the EPA. The data include the results of previous investigations, historical uses and operations, regional geologic, hydrogeologic, and hydrologic information; surrounding land and water use; and other relevant information gathered. The quality of the data was evaluated and presented in the OU3 RIR (TRC, 2016).

New data are needed to characterize the current extent of the perchlorate plume and evaluate the current biogeochemical conditions in groundwater. The following data will be collected according to this work plan to address these needs:

- Analytical parameters: perchlorate, total and dissolved iron, nitrate, sulfate, sulfide, orthophosphate, alkalinity, total organic carbon, total dissolved solids, and dissolved hydrocarbons (methane, ethane, ethene)
- Water quality parameters: pH, temperature, dissolved oxygen, oxidation reduction potential, turbidity, and specific conductivity
- Compound Specific Isotope Analysis
- Gene-Trac
- Water level measurements

Step 4. Identify the Boundaries of the Study – This step is used to define the geographic and temporal boundaries. The boundary of the study area is the extent of the perchlorate plume resulting from Site activities. Sampling activities are expected to start in summer of 2019 and may be continued based upon the results of the initial investigation.

Step 5. Develop the Analytic Approach – The analytic approach summarizes how the information collected during the RI will guide the selection of an appropriate remedy. Samples will be collected and analyzed according to the sampling design provided in Worksheet #17 of the Quality Assurance Project Plan (QAPP). The sampling approach and set of analytical parameters are described in Section 4 of this Work Plan. The below table describes how the data inputs will be used to guide remedy selection.

Perchlorate	Biogeochemical Parameters (1) and Water Quality Parameters (2)	Groundwater Level Measurements	Compound Specific Isotope Analysis
If the perchlorate concentrations at wells along the perimeter of the plume are less than 5 µg/L then the plume will be considered delineated. If not, then additional wells may be installed to delineate the plume.	If the biogeochemical parameter data support natural attenuation, then natural attenuation will be considered as a remedy. If not, then natural attenuation will not be considered as a remedy.	If the groundwater level data are consistent, then the direction of groundwater flow will be determined. If not, then additional groundwater elevation data may be collected.	If the data show evidence of perchlorate with isotopic weights similar to natural sources found in fertilizer, then this information will be used to support the assumption that perchlorate is present in the background. If not, then perchlorate may not be present in the background.

1. Biogeochemical parameters - total and dissolved iron, nitrate, sulfate, sulfide, orthophosphate, alkalinity, total organic carbon, total dissolved solids, and dissolved hydrocarbons (methane, ethane, ethene)
2. Water quality parameters - pH, temperature, dissolved oxygen, oxidation reduction potential, turbidity, and specific conductivity

Step 6. Specify Performance or Acceptance Criteria – Uncertainty is present in all measurement data, and this step sets the standards at which the degree of uncertainty is acceptable. Project-specific standards details regarding the precision and accuracy control limits for each of the target analytes and matrices, as well as the overall project goals for completeness and representativeness are described in the QAPP.

Step 7. Develop the Plan for Obtaining Data – Sections 3 and 4 provide detailed information for collection of data sufficient to delineate perchlorate in groundwater. This Work Plan includes maps depicting sampling locations; a detailed description of the sampling analysis and testing to be performed, including sampling methods, analytical and testing methods, and frequency of sampling; and a description of how sampling data will be submitted to the EPA.

4. SAMPLING DESIGN AND RATIONALE

The following section summarizes the sampling design and rationale which will serve to characterize the perchlorate plume. Perchlorate concentrations will be delineated to the 5 ppb GWQS. All investigative methods shall be consistent with generally accepted professional methods, as described in the USEPA Region II Ground Water Sampling Procedure (USEPA, 1998). The groundwater investigation will be conducted pursuant to the requirements in N.J.A.C. 7:26E-4.1 and according to the quality assurance and quality control requirements pursuant to N.J.A.C. 7:26E-2.

Two rounds of sampling will be conducted. The initial sampling round will focus on perchlorate and biogeochemical evaluation. The second sampling round may include groundwater level measurements, perchlorate analysis, biogeochemical analysis, compound-specific isotope analysis (CSIA) and Gene-Trac testing, depending on the results of the initial sampling round.

4.1 Proposed Perchlorate Sampling Locations

Perchlorate concentrations in the shallow, intermediate and deep portions of the aquifer will be assessed from 60 of the existing 68 monitoring wells that were historically sampled for perchlorate. The sampling list includes on-Site and off-Site monitoring wells, Farm Parcel monitoring wells, and off-Site extraction wells (Figures 4 and 5). Perchlorate will be analyzed during the initial sampling round. Table 1 lists the sampling locations, depths, and analyses. Table 2 presents the well construction specifications. Samples will be collected from the mid-point of the screened interval. Eight monitoring wells (IWC-1, B, L, SC12S, SC23S, SC27S, SC6S, and SC19S) were excluded from the sampling plan because the screened interval was the same as one or more monitoring wells within close proximity.

If a sample cannot be collected at a planned location (e.g. if the monitoring well has been damaged), nearby locations will be evaluated to determine if the screened interval depth is similar to the proposed monitoring well. If so, the nearby monitoring well with the most closely aligned screened interval may be substituted into the sampling plan.

4.2 Background Locations

Background locations are hydraulically upgradient of the former wastewater lagoons and Former Chemical Storage Building and have low or no detectable perchlorate concentrations in previous sampling rounds. These locations will serve to compare Site conditions to the surrounding environment. Background groundwater samples will be collected from monitoring wells SC14S, SC15S, and SC16S, all of which had no detected concentrations of perchlorate in the 2009 and 2010 sampling rounds and are located upgradient of the perchlorate source areas. Background samples will also be collected further upgradient at monitoring wells SC25S and OBS–2A which had low estimated concentrations of perchlorate in the 2009 and 2010 sampling rounds. Background wells will be sampled before any other on-Site or off-Site well.

4.3 Groundwater Quality and Biogeochemical Parameter Investigation

Biogeochemical parameters including total and dissolved iron, nitrate, sulfate, sulfide, orthophosphate, alkalinity, total organic carbon, and total dissolved solids, will be analyzed

during the initial sampling round at 30 locations where perchlorate was previously detected. Samples for dissolved hydrocarbon (methane, ethane, and ethene) analyses will be collected at one shallow and one intermediate location (RW6S and Layne) and ten deep locations (SC1D, SC3D(R), SC6D, SC10D, SC19D, SC20D, SC21D, SC28D, SC34D, and W3D). These locations were chosen because they had the highest perchlorate concentrations during previous sampling events. In addition, field parameters, specifically temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation reduction potential (ORP), will be monitored while purging at each location. These data will be reviewed to evaluate the processes that may be breaking down perchlorate. Table 1 details the analyses that will be performed at each location.

4.4 CSIA and Gene-Trac Sampling Locations

Groundwater samples for CSIA and Gene-Trac testing may be collected during the second sampling event at up to 12 locations which will be determined based on concentrations observed during the initial sampling event.

CSIA samples will preferentially be collected at locations on the perimeter of the perchlorate plume and with perchlorate concentrations of at least 5 micrograms per liter (µg/L). Higher concentrations of perchlorate are preferred because the sampling procedure for CSIA, discussed in detail in the Field Sampling Plan (FSP), requires pumping a large volume of water (i.e., 2,000 liters for a well with a perchlorate concentration of 5 µg/L) through an ion exchange column at a rate of no greater than 2 liters per minute to adsorb all perchlorate to the resin within the ion exchange column. Samples will be analyzed by CSIA to determine the isotopic weight of the perchlorate. This will provide evidence of the source of the perchlorate, as the synthetic perchlorate likely used at the Site has a lower isotopic weight than natural perchlorate found in fertilizers used in farms near the Site.

Gene-Trac testing will be used to quantify key microorganisms and to determine microbial composition for the assessment of bioremediation potential. Samples for Gene-Trac testing will be collected at locations with the highest perchlorate concentrations during the initial sampling round. The Gene-Trac samples will be processed, frozen, and held for analysis until a remedy is selected. They will be analyzed if the selected remedy includes a bioremediation component that requires bacterial analysis.

5. SAMPLE COLLECTION

All samples will be collected and handled in accordance with the USEPA Region II Ground Water Sampling Procedure (USEPA, 1998). Personnel responsible for sample handling, custody, and disposal are designated in QAPP worksheet #26 and 27, Appendix B.

5.1 Purging Procedures

All wells will be purged prior to sampling. A peristaltic pump will be used for purging, and clean polyethylene tubing will be used for groundwater extraction. All tubing will be dedicated to specific wells. Tubing intake will be placed within the middle of the screened interval to be best situated to capture groundwater flowing into the well from the aquifer.

Water will be collected in a measured bucket to record the purge volume. Wells will be purged until water quality indicator parameters (pH, temperature, specific conductivity, dissolved oxygen, oxidation reduction potential (ORP/eh), and turbidity) stabilize or until three well volumes have been evacuated, whichever criteria is met first. Water quality indicator parameters will be considered stable when they meet the following criteria for three consecutive readings taken at five-minute intervals:

- water level drawdown <0.3 ft;
- temperature +/- 3%;
- pH +/- 0.1 pH units;
- specific conductance +/- 3%;
- dissolved oxygen +/- 10% for values greater than 0.5 mg/L, if three dissolved oxygen values are less than 0.5 mg/L, consider the values as stabilized;
- turbidity +/- 10% for values greater than 5 NTU, for values less than 5 NTUs, consider the values as stabilized; and
- ORP/eh +/- 10 millivolts.

In the event that field parameters do not stabilize within four hours, purging will be discontinued, and a sample will be collected.

5.2 Sampling Procedures

At each sampling location, all bottles designated for a particular analysis will be filled sequentially before bottles designated for the next analysis are filled. If a duplicate sample is to be collected at the location, all bottles designated for a particular analysis for both sample designations will be filled sequentially before bottles for another analysis are filled, as described in Section 7.3. Bottleware for dissolved hydrocarbon analysis will be filled before samples of other chemical groups. Groundwater samples will be transferred directly into the appropriate sample containers with preservative, if required, placed on ice in a cooler, and processed for shipment to the laboratory.

5.3 Calibration

Field equipment, specifically the YSI and turbidity meter, will be calibrated at the beginning of each day and the calibration will be checked at the end of each day according to Geosyntec Standard Operating Procedure (SOP) 110, included in Appendix C for reference. Calibration is discussed in further detail in the FSP.

6. DOCUMENTATION

Complete and accurate documentation is essential to demonstrate that field measurement and sampling procedures are carried out as described in the QAPP. Technical records generated during the groundwater investigation will be in sufficient detail to support decisions made and will be maintained by the field lead. The field logbooks will provide documentation of any deviations from the QAPP, a brief rationale, and any details relevant to the changes in procedure. All documents will be archived at the Geosyntec office or off-Site storage facility and included in reports submitted to USEPA.

6.1 Field Log Book

Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities, as described in QAPP Worksheet 29 (Appendix B). Field personnel will adhere to the following general guidelines for maintaining field documentation:

- Documentation will be completed in permanent ink;
- Entries will be legible;
- Errors will be corrected by crossing out with a single line and then dating and initialing the lineout;
- Any serialized documents will be maintained in the project file and referenced in the Site logbook, and;
- Unused portions of pages will be crossed out, and each page will be signed and dated.

6.2 Sample Labeling

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory, as described in QAPP Worksheet 27 (Appendix B). The sample identifier (ID) will include the well ID and date of sample collection. At a minimum, the sample labels will contain the following information: project name, sample ID, date and time of collection, sample collector's initials, and method of preservation.

6.3 Chain of Custody

Field personnel will use standard sample custody procedures as described in QAPP Worksheets #26 and 27 (Appendix B) to maintain and document sample integrity during collection, transportation, storage, and analysis. The chain of custody record will be used to document all samples collected and the analyses requested. Field personnel will sign chain of custody records that are initiated in the field and will retain copies of these records and applicable air bills.

To ensure that sample custody is maintained and recorded, a sample will be considered to be in custody if one of the following statements applies:

- It is in a person's physical possession or view;

- It is in a secure area with restricted access, or;
- It is placed in a container and secured with an official seal so that the sample cannot be reached without breaking the seal.

6.4 Laboratory Deliverables

Data generated during laboratory analysis will follow the specifications described in QAPP Worksheet 29 (Appendix B).

7. QUALITY ASSURANCE/QUALITY CONTROL

7.1 Field Blanks and Equipment Blanks

Field blanks will be collected to evaluate whether contaminants have been introduced into the samples during the sampling due to ambient conditions or from sample containers. Field blank samples will be obtained by pouring deionized water into a sampling container at the sampling point. One equipment rinsate blank will be collected each day that sampling is conducted.

Equipment rinsate blanks will be collected to evaluate field sampling and decontamination procedures by pouring deionized water over the decontaminated sampling equipment and into the sampling container. One equipment rinsate blank will be collected each day that sampling equipment is decontaminated in the field. Equipment rinsate blanks will be obtained by passing water through or over the decontaminated sampling devices used that day.

The field and equipment rinsate blanks will be preserved, packaged, and sealed in the manner described for the environmental samples.

7.2 Temperature Blanks

For each cooler that is shipped or transported to an analytical laboratory a bottle will be included that is marked “temperature blank.” This blank will be used by the sample custodian to check the temperature of samples upon receipt.

7.3 Trip Blanks

A laboratory supplied trip blank will accompany dissolved hydrocarbon bottleware during shipment from the lab, transport on Site, and return shipment to the lab.

7.4 Duplicates

Duplicate water samples will be collected from select intermediate and deep monitoring wells because these aquifer zones are anticipated to exhibit moderate concentrations of contaminants. When collecting duplicate water samples, bottles with the two different sample identification numbers will alternate in the filling sequence (e.g., a typical filling sequence might be: dissolved hydrocarbons designation GW-2, dissolved hydrocarbons designation DUP-01 (duplicate of GW-2); metals designation GW-2, metals designation DUP-01, (duplicate of GW-2) etc.). Note that bottles for one type of analysis will be filled before bottles for the next analysis are filled. Bottles for dissolved hydrocarbons will always be filled first.

Duplicate samples will be preserved, packaged, and sealed in the same manner as other samples of the same matrix. A separate sample number and station number will be assigned to each duplicate, and it will be submitted blind to the laboratory.

7.5 Decontamination of Sampling Equipment

The decontamination procedures that will be followed are in accordance with NJDEP approved procedures. Decontamination of sampling equipment must be conducted consistently as to assure the quality of samples collected. All equipment that comes into contact with potentially

contaminated groundwater will be decontaminated. Decontamination will occur after each use of a piece of equipment.

The field sampling equipment cleaning and decontamination procedures are as follows:

- Laboratory grade glassware detergent and tap water scrub to remove visual contamination;
- Generous tap water rinse; and,
- Distilled and deionized (ASTM Type II) water rinse

All sampling equipment decontaminated via this procedure will be wrapped in aluminum foil during storage and prior to use to ensure that it remains clean prior to the next use.

Disposable equipment intended for one-time use will not be decontaminated, but will be packaged for appropriate disposal.

7.6 Data Validation Procedures

After the data are received from the laboratory, data validation will occur as described in the UFP QAPP Worksheet #36, Appendix B. Stage 2A validation will be performed on 25% of all samples. Where necessary, data qualifiers will be assigned to provide the basis of describing data quality. Validation qualifiers, reason codes, and comments (as warranted) will be added to each EDD and uploaded to the project database. This information will be supplied to the project team via a validation report and to the data manager through updates to the database.

7.7 Data Usability Assessment

A data usability assessment will be performed on a periodic basis summarizing the overall quality of the data including field data, field QC data, laboratory QC data, and laboratory data. This will further illustrate the limitations of any qualified data that may have resulted during data validation. The data will be evaluated with regard to compliance with the DQOs and measurement quality objectives. Should non-conformance issues be generated from the laboratory, the validation procedure will evaluate the impacts of the nonconformance(s) on the quality and usability of the data set. Data usability will be assessed with respect to the DQOs and the limits specified in the UFP QAPP Worksheet #37, Appendix B.

8. HEALTH AND SAFETY PLAN

A Site-Specific Health and Safety Plan (HASP) is included as Appendix D. Geosyntec field personnel will have 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) Training and will be current with OSHA HAZWOPER refresher training and medical monitoring. In addition, field personnel will participate in a medical monitoring program.

9. REPORTING

Following the completion of the first round of sampling and analysis, data will be summarized in a presentation to USEPA. The need for additional sampling will be evaluated at that time. Following the completion of sampling and analysis, data will be compiled in a Groundwater Summary Memorandum. Electronic data deliverables will be submitted as specified in the QAPP. Following concurrence from USEPA, a DSRA and Feasibility Study will be produced to evaluate remedial options for the Site.

10. SCHEDULE

The groundwater sampling event will be scheduled to occur approximately one month following USEPA and NJDEP approval of the GIWP, FSP, HASP, and QAPP. The initial sampling round is anticipated to take one to two weeks to complete, and analytical results are expected to be received approximately one month following sampling. The below table outlines the expected completion dates.

Task	Expected Date of Completion
Submittal of the project planning documents (GIWP, QAPP, FSP, HASP, GMP, ICTM) to USEPA	May 2019
Address USEPA comments and finalize project planning documents	July 2019
Groundwater sampling field event	August 2019
Submission of Groundwater Summary Memorandum to USEPA	December 2019
Address USEPA comments and finalize Groundwater Summary Memorandum	February 2020
Submit DSRA to USEPA	February 2020
Address USEPA comments and finalize DSRA	April 2020
Submit Feasibility Study Report to USEPA	June 2020
Presentation on Feasibility Study Report to USEPA	July 2020

11. REFERENCES

NJDEP. 2018. *Ground Water Quality Standards.*

TRC. 2008. *Draft Final Perchlorate Remedial Investigation Work Plan.*

TRC. 2011. *OU1 Supplemental Remedial Investigation Report.*

TRC. 2013. *Final OU3 Screening Level Ecological Risk Assessment.*

TRC. 2014. *Draft Final OU3 Human Health Risk Assessment.*

TRC. 2015. *Final Draft OU1 Feasibility Study.*

TRC. 2016. *Remedial Investigation Report.*

USEPA. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.*

USEPA. 2015. *Record of Decision Amendment. Operable Unit #1 ShieldAlloy Metallurgical Corporation, Newfield, Gloucester County, New Jersey.*

TABLES

Table 1: Sample Locations and Analyses
Groundwater Investigation Work Plan
Shieldalloy Metallurgical Corporation Superfund Site
Newfield, NJ

Well ID	Sample Depth (ft btoc)	Relative Aquifer Depth	Analyses											
			Perchlorate	Total and Dissolved Iron	Nitrate	Sulfate	Sulfide	Orthophosphate	Alkalinity	Total Organic Carbon	Total Dissolved Solids	Methane, Ethane, Ethene	Compound Specific Isotope Analysis (1)	Gene-Trac (1)
On Site Monitoring Wells														
IWC-2	37	Shallow	x	x	x	x	x	x	x	x	x	-	-	-
IWC-3	57	Intermediate	x	x	x	x	x	x	x	x	x	-	-	-
IWC-4	77	Intermediate	x	x	x	x	x	x	x	x	x	-	-	-
IWC-5	97	Deep	x	x	x	x	x	x	x	x	x	-	-	-
A	119	Deep	x	-	-	-	-	-	-	-	-	-	-	-
K	41	Shallow	x	x	x	x	x	x	x	x	x	-	-	-
SC9S	22	Shallow	x	x	x	x	x	x	x	x	x	-	-	-
SC11S(R)	16	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC12D	131	Deep	x	-	-	-	-	-	-	-	-	-	-	-
SC13S(R)	20	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC13D	132	Deep	x	-	-	-	-	-	-	-	-	-	-	-
SC14S	19	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC15S	20	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC16S	19	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC20S	14	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC20D	134	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC22S	10	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC25S	14	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
MWH-4	124	Deep	x	-	-	-	-	-	-	-	-	-	-	-
W2(R)	9	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
W3D	98	Deep	x	x	x	x	x	x	x	x	x	x	-	-
W4	65	Intermediate	x	-	-	-	-	-	-	-	-	-	-	-
On Site Extraction Wells														
Layne	44	Shallow	x	x	x	x	x	x	x	x	x	x	-	-
W9	120	Deep	x	x	x	x	x	x	x	x	x	-	-	-
Farm Parcel Monitoring Wells														
IW2	55	Intermediate	x	x	x	x	x	x	x	x	x	-	-	-
SC1S	45	Intermediate	x	-	-	-	-	-	-	-	-	-	-	-
SC1D	90/107	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC2D(R)	111	Deep	x	x	x	x	x	x	x	x	x	-	-	-
SC3S	45	Intermediate	x	x	x	x	x	x	x	x	x	-	-	-
SC3D(R)	107	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC5S	12	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC5D	105	Deep	x	-	-	-	-	-	-	-	-	-	-	-
SC24S	12	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC24D	110	Deep	x	x	x	x	x	x	x	x	x	-	-	-
SC31D	125	Deep	x	x	x	x	x	x	x	x	x	-	-	-

Table 1: Sample Locations and Analyses
Groundwater Investigation Work Plan
Shieldalloy Metallurgical Corporation Superfund Site
Newfield, NJ

Well ID	Sample Depth (ft btoc)	Relative Aquifer Depth	Analyses											
			Perchlorate	Total and Dissolved Iron	Nitrate	Sulfate	Sulfide	Orthophosphate	Alkalinity	Total Organic Carbon	Total Dissolved Solids	Methane, Ethane, Ethene	Compound Specific Isotope Analysis (1)	Gene-Trac (1)
Off Site Monitoring Wells														
OBS-2A	139	Deep	x	-	-	-	-	-	-	-	-	-	-	-
IW1	47	Intermediate	x	-	-	-	-	-	-	-	-	-	-	-
SC4S	40	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC6D	115	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC10S	45	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC10D	115	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC17S	23	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC17D	148	Deep	x	-	-	-	-	-	-	-	-	-	-	-
SC18S	11	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC18D	124	Deep	x	x	x	x	x	x	x	x	x	-	-	-
SC19D	125	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC21S	10	Shallow	x	-	-	-	-	-	-	-	-	-	-	-
SC21D	130	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC26D	132	Deep	x	x	x	x	x	x	x	x	x	-	-	-
SC28D	143	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC30D	152	Deep	x	-	-	-	-	-	-	-	-	-	-	-
SC32D	97	Deep	x	x	x	x	x	x	x	x	x	-	-	-
SC33D	88	Intermediate	x	-	-	-	-	-	-	-	-	-	-	-
SC34D	135	Deep	x	x	x	x	x	x	x	x	x	x	-	-
SC35D	95	Deep	x	-	-	-	-	-	-	-	-	-	-	-
SC36D	112	Deep	x	x	x	x	x	x	x	x	x	-	-	-
SC40D	125	Deep	x	-	-	-	-	-	-	-	-	-	-	-
Off Site Extraction Wells														
RIW2	42	Shallow	x	x	x	x	x	x	x	x	x	-	-	-
RW6S	65	Intermediate	x	x	x	x	x	x	x	x	x	x	-	-
RW6D	107	Deep	x	x	x	x	x	x	x	x	x	-	-	-
Quality Control Samples (fill in parent sample in field)														
DUP-01			x	x	x	x	x	x	x	x	x	x	1 per 10	-
DUP-02			x	x	x	x	x	x	x	x	x	-	1 per 10	-
DUP-03			x	-	-	-	-	-	-	-	-	-	1 per 10	-
MS/MSD			x	x	x	x	x	x	x	x	x	x	-	-
MS/MSD			x	x	x	x	x	x	x	x	x	-	-	-
MS/MSD			x	-	-	-	-	-	-	-	-	-	-	-

Notes:
1. CSIA and Gene-Trac samples will be collected during a second sampling event at locations determined by concentrations observed during the initial sampling event.
ft btoc - feet below top of casing
Well IDs highlighted blue are considered background locations and will be sampled first.
All samples will be collected as per the USEPA Region 2 low-flow purge protocol and Geosyntec Standard Operating Procedure 108
Sample IDs will follow the format: Well ID_YYYYMMDD

Table 2: Well Construction Specifications
ShieldAlloy Metallurgical Corporation Superfund Site
Newfield, NJ

Well ID	Permit #	Installation Date	Casing Type / Diameter	Ground Elevation (msl) [1]	Top of Inner Casing Elevation (msl) [1]	Total Well Depth (ft) [2]	Screened Interval (ft) [2]	Top of Screen Elevation (msl) [1] [3]	Bottom of Screen Elevation (msl) [1] [3]
A	51-142	1970	STEEL/2"	-	94.82	124	114 to 124	-21.18	-31.18
IWC-3	51-222	1/74	STEEL/2"	-	97.83	60	55 to 60	40.83	35.83
IWC-4	51-223	1/74	STEEL/2"	-	98.61	80	75 to 80	21.61	16.61
IWC-5	51-224	1/74	STEEL/2"	-	98.03	100	95 to 100	1.03	-3.97
W3D	31-25759	12/5/1986	PVC/4"	-	108.37	108	88 to 108	18.37	-1.63
W4	51-219	5/8/1974	PVC/4"	-	104.58	75	55 to 75	47.58	27.58
W9	31-19648	10/17/1982	PVC/6"	92.43	94.43	130	110 to 130	-17.57	-37.57
MWH-4	UNK	2/7/2002	PVC/6"	97.54	99.37	129	119 to 129	-21.46	-31.46
SC12D	31-35226-0	11/28/1990	PVC/4"	102.16	103.19	140	126 to 136	-23.84	-33.84
SC13D	31-35227-8	11/29/1990	PVC/4"	99.67	101.99	140.5	127 to 137	-27.33	-37.33
SC20D	31-38187	1/10/1992	PVC/4"	101.55	104.53	139	129 to 139	-27.45	-37.45
SC22D	31-35222-7	11/21/1990	PVC/4"	96.18	98.65	125	111 to 121	-14.82	-24.82
SC1D	31-21619-6	5/30/1984	PVC/2"	88.00	90.90	115	85-95/100-115	3 to -7	-12 to -27
SC2D(R)	31-38194	1/3/1992	PVC/4"	90.62	92.53	-	106 to 116	-15.38	-25.38
SC3D(R)	31-38195	1/7/1992	PVC/4"	88.75	91.06	-	102 to 112	-13.25	-23.25
SC4D	31-21690-1	6/8/1984	PVC/2"	-	92.64	120	110 to 120	-19.36	-29.36
SC5D	31-21876-8	6/12/1984	PVC/2"	-	97.00	120	90 to 120	5.00	-25
SC6D	31-21878-4	6/26/1984	PVC/2"	-	94.38	125	110 to 120	-17.62	-27.62
SC10D	31-23370	11/12/1985	PVC/4"	-	95.72	125	105 to 125	-11.28	-31.28
SC17D	31-35223-5	11/27/1990	PVC/4"	106.48	108.07	153	143 to 153	-36.52	-46.52
SC18D	31-35228-6	11/20/1990	PVC/4"	93.56	96.01	130	119 to 129	-25.44	-35.44
SC19D	31-35221-9	11/26/1990	PVC/4"	89.65	92.03	133	120 to 130	-30.35	-40.35
SC21D	31-35220-1	11/27/1990	PVC/4"	90.44	91.65	140	125 to 135	-34.56	-44.56
SC24D	3142083	8/24/1993	PVC/4"	-	93.52	115	105 to 115	-13.48	-23.48
SC26D	31-39500	7/9/1992	PVC/4"	100.68	100.45	143	127 to 137	-26.32	-36.32
IW2	31-23369	11/12/1985	PVC/6"	-	92.05	70	40 to 70	50.05	20.05
SC28D	31-47408	8/16/1995	PVC/4"	107.41	106.87	153	133 to 153	-25.59	-45.59
SC29D	31-47409	2/20/1997	PVC/4"	106.50	106.23	148	128 to 148	-21.5	-41.5
SC30D	31-63686	6/14/2002	PVC/2"	114.59	115.58	157	147 to 157	-32.41	-42.41
SC31D	31-66758	6/25/2002	PVC/2"	99.78	102.61	130	120 to 130	-20.22	-30.22
SC32D	35-27314	12/18/2006	PVC/2"	-	91.62	102	92 to 102	-0.38	-10.38
SC33D	P200912475	10/22/2009	PVC/2"	-	108.08	92.5	82.5 to 92.5	23.58	13.58
SC34D	P200912473	10/22/2009	PVC/2"	-	103.82	142	132 to 142	-30.18	-40.18
SC35D	P200913690	10/29/2009	PVC/2"	-	81.24	99.5	89.5 to 99.5	-10.26	-20.26
SC36D	P200912476	11/4/2009	PVC/2"	-	91.80	117	107 to 117	-17.2	-27.2
SC40D	E201104448	4/5/2011	PVC/2"	-	98.12	130	120 to 130	-21.88	-31.88
OBS-2A^	31-06092	-	-	120.00	122.80	154	129 to 149	-8.2	-28.2
B	51-143	1970	STEEL/2"	-	94.33	46	36 to 46	56.33	46.33
K	51-152	1971	STEEL/2"	-	99.18	46	36 to 46	61.18	51.18
L	51-153	1971	STEEL/2"	-	103.51	52	42 to 52	59.51	49.51
Layne	51-154	1971	STEEL/6"	92.11	94.11	48	43 to 48	49.11	44.11
IWC-1	51-220	1/74	STEEL/2"	-	98.13	20	15 to 20	81.13	76.13
IWC-2	51-221	1/74	STEEL/2"	-	98.51	40	35 to 40	61.51	56.51
W2(R)	31-38189	12/20/1991	PVC/4"	95.88	97.96	17	2 to 17	93.88	78.88
SC9S	31-23368-6	8/1/1985	PVC/4"	-	96.23	30	15 to 30	79.23	64.23
SC11S(R)	31-39512	7/1/1992	PVC/4"	106.91	108.12	24	9 to 24	97.91	82.91
SC12S	31-29140-6	9/2/1988	PVC/2"	-	104.76	25	15 to 25	87.76	77.76
SC13S(R)[@]	31-00076422	6/25/2008	PVC/2"	-	101.10	25	15 to 25	83.6	73.6

Table 2: Well Construction Specifications
ShieldAlloy Metallurgical Corporation Superfund Site
Newfield, NJ

Well ID	Permit #	Installation Date	Casing Type / Diameter	Ground Elevation (msl) [1]	Top of Inner Casing Elevation (msl) [1]	Total Well Depth (ft) [2]	Screened Interval (ft) [2]	Top of Screen Elevation (msl) [1] [3]	Bottom of Screen Elevation (msl) [1] [3]
SC14S	31-35215-4	11/15/1990	PVC/4"	105.83	108.38	27	12 to 27	93.83	78.83
SC15S	31-35216-2	11/13/1990	PVC/4"	106.06	108.32	27.5	12.5 to 27.5	93.56	78.56
SC16S	31-35217-5	11/14/1990	PVC/4"	105.32	108.05	27	12 to 27	93.32	78.32
SC20S	31-35218-3	11/13/1990	PVC/4"	101.74	104.45	22	7 to 22	94.74	79.74
SC22S	31-35219-7	11/14/1990	PVC/4"	96.17	99.65	18	3 to 18	93.17	78.17
SC23S	31-35437-8	11/16/1990	PVC/4"	102.83	102.21	24	9 to 24	93.83	78.83
SC25S	31-38188	12/23/1991	PVC/4"	-	102.27	21	6 to 21	94.27	79.27
SC27S	31-41031	12/15/1992	PVC/4"	-	100.54	22	7 to 22	91.54	76.54
SC1S	31-28825-1	6/22/1988	PVC/4"	-	87.26	55	35 to 55	50.26	30.26
SC3S	31-28914-2	6/8/1988	PVC/4"	-	90.32	55	35 to 55	53.32	33.32
SC4S	31-21689-7	6/7/1984	PVC/2"	-	93.65	45	35 to 45	56.65	46.65
SC5S	31-35434-1	11/28/1990	PVC/4"	94.18	96.55	20	5 to 20	89.18	74.18
SC6S	31-21691-5	6/21/1984	PVC/2"	-	94.62	75	45 to 75	47.62	17.62
SC10S	31-23369	11/11/1985	PVC/4"	-	95.38	55	35 to 55	58.38	38.38
SC17S	31-35229-4	11/19/1990	PVC/4"	106.53	109.26	28	13 to 28	93.53	78.53
SC18S	31-35230-8	11/15/1990	PVC/4"	93.43	95.72	19	4 to 19	89.43	74.43
SC19S	31-35224-3	11/15/1990	PVC/4"	90.14	92.98	17	2 to 17	88.14	73.14
SC21S	31-35225-1	11/15/1990	PVC/4"	90.57	92.64	18	3 to 18	87.57	72.57
SC24S	31-35435-1	11/28/1990	PVC/4"	91.57	93.57	20	5 to 20	86.57	71.57
IW1	-	4/5/1983	PVC/6"	89.06	90.33	62	32 to 62	57.06	27.06
RIW2	-	-	-	-	-	-	30 to 55	-	-
RW6S	-	-	-	-	-	-	55 to 75	-	-
RW6D	-	-	-	-	-	-	90 to 125	-	-

Notes:

(1) - All elevations based on vertical datum NGVD 1929

(2) - Feet Below Grade

(3) - Screened interval elevations for well locations without surveyed ground elevations calculated assuming a ground elevation of 2 feet below the surveyed well elevation (i.e., top of inner casing elevation).

^ - USGS observation well (NJ-WRD Well Number 15-0372) land surface is 120 feet above NGVD 1929, with the measuring point 2.80 ft above the land surface. The total well depth is 154 feet, with a screened interval of 129-149 feet below grade. (USGS Water Resources Data, New Jersey Water Year 2002 Vol. 2: Water Data Report NJ-02-2)

@ - Original monitoring well SC-13S destroyed; Well was reinstalled and named SC-13S(R). msl - Feet Above Mean Sea Level

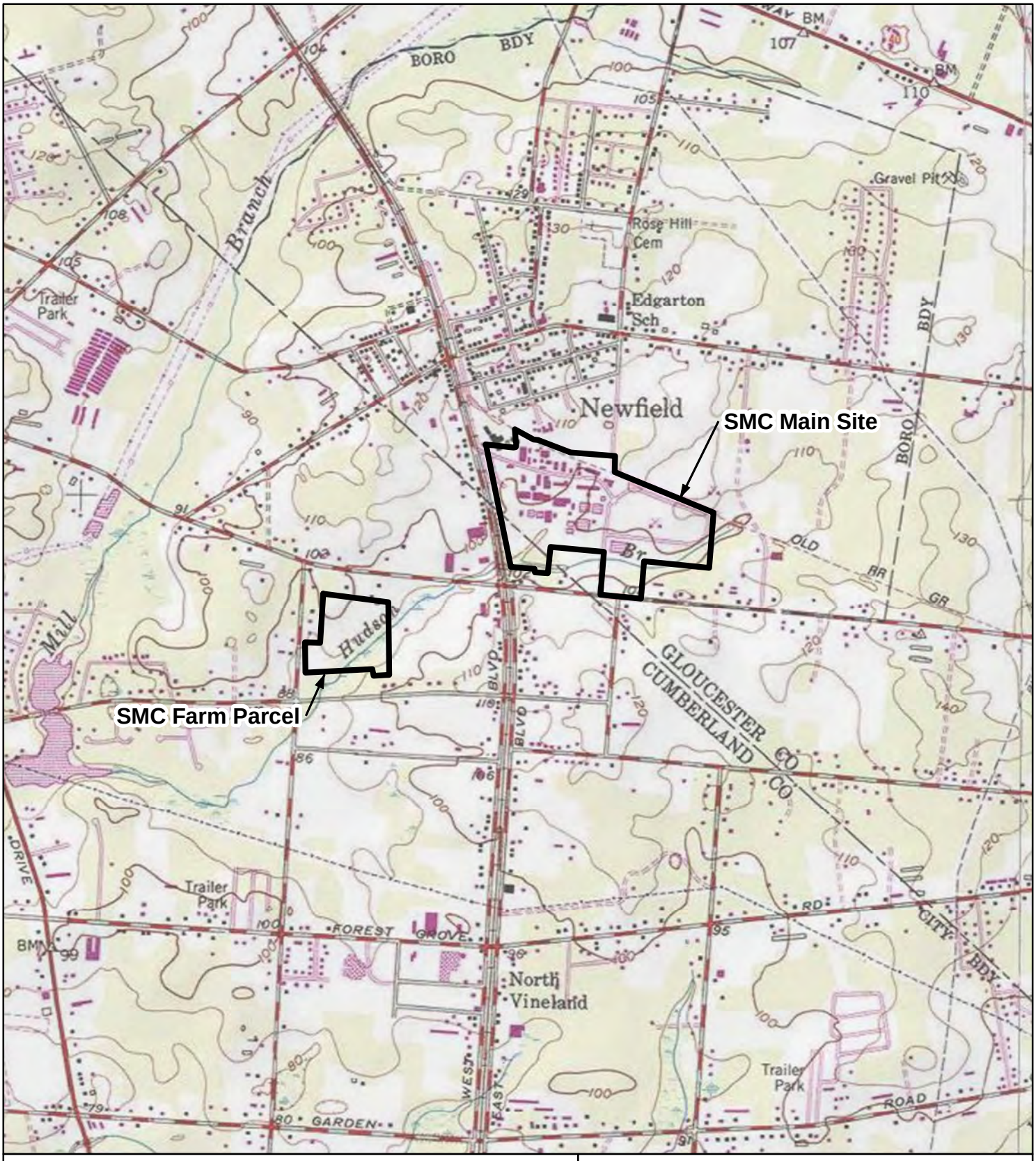
ft - Feet

NM - Not Measured

NI - Well not installed

UNK - Unkown

FIGURES



Legend

Site Property Boundary

N

0 1,680 Feet

Notes
Base Map: USGS Topographic Map

Site Location

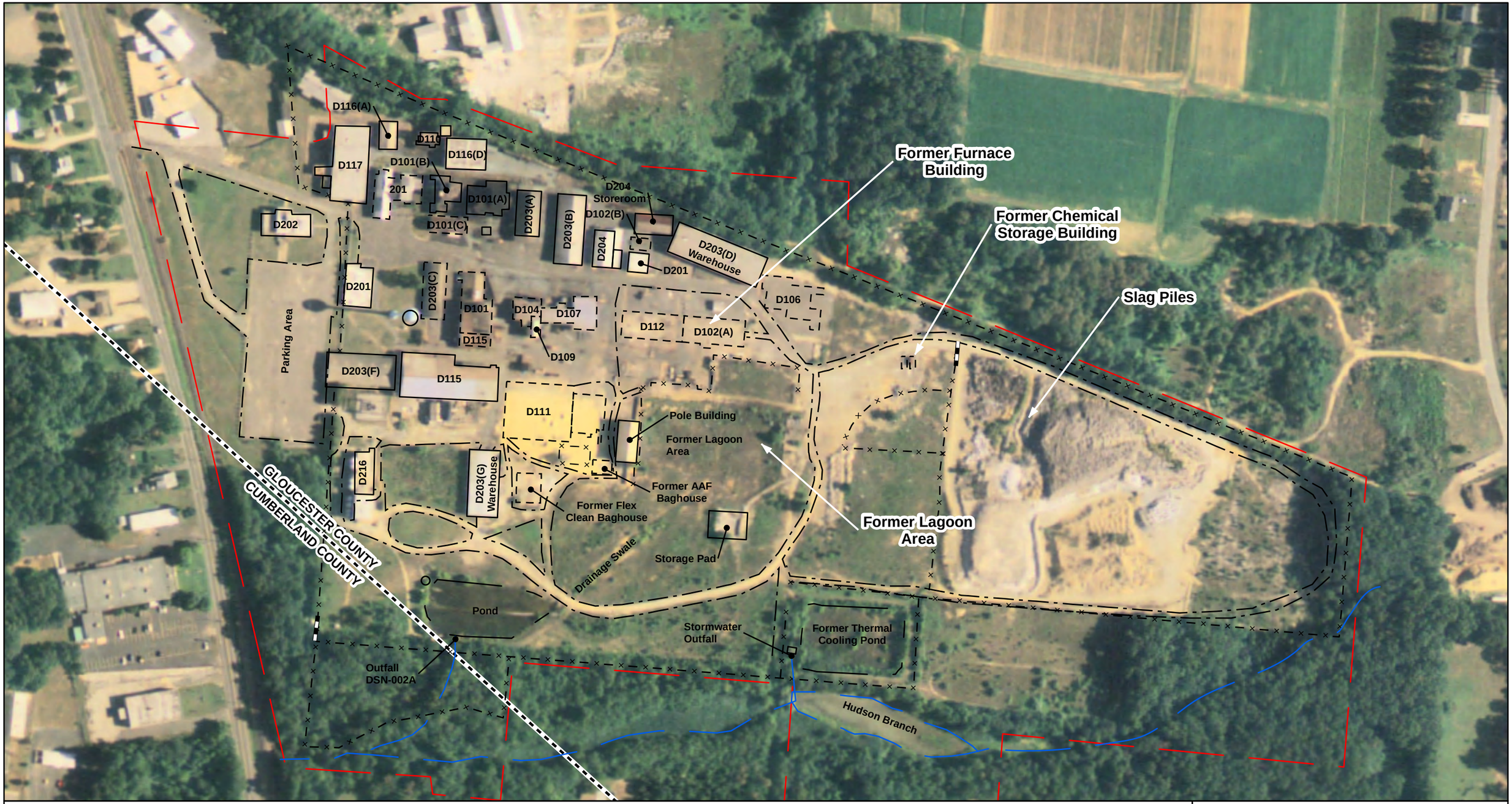
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

Blue Bell, PA | May 2019

Figure 1

P:\GIS\GISprojects\JR0241 - Sheildalloy\Fig 1 Site Location Map.mxd 1/22/2019 11:22:11 AM



Legend

- Site Property Boundary
- Current Building
- Demolished Building
- Pond
- Road
- Fence Line
- Stream
- Gate

Notes:
The information in this figure is based on TRC Figure 2 from the 2012 OU3 Draft Final Conceptual Site Model and Memorandum of Exposure Scenarios and Assumptions.

N

0 280 Feet

Areas of Historic Perchlorate Use

Sheildalloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

Blue Bell, PA | May 2019

Figure 2

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Legend

- Monitoring Wells
- Off Site Vertical Profiling Location
- Site Property Boundary
- Current Building
- Demolished Building
- Fence Line
- Pond
- Road
- Gate
- Fence Line
- Water Feature

N

0 1,140 Feet

Notes:
The information in this figure is based on TRC Figure 2-3 from the 2011 OU3 Perchlorate Site Characterization Summary Report.

Vertical Profile Borings and Related Monitoring Wells

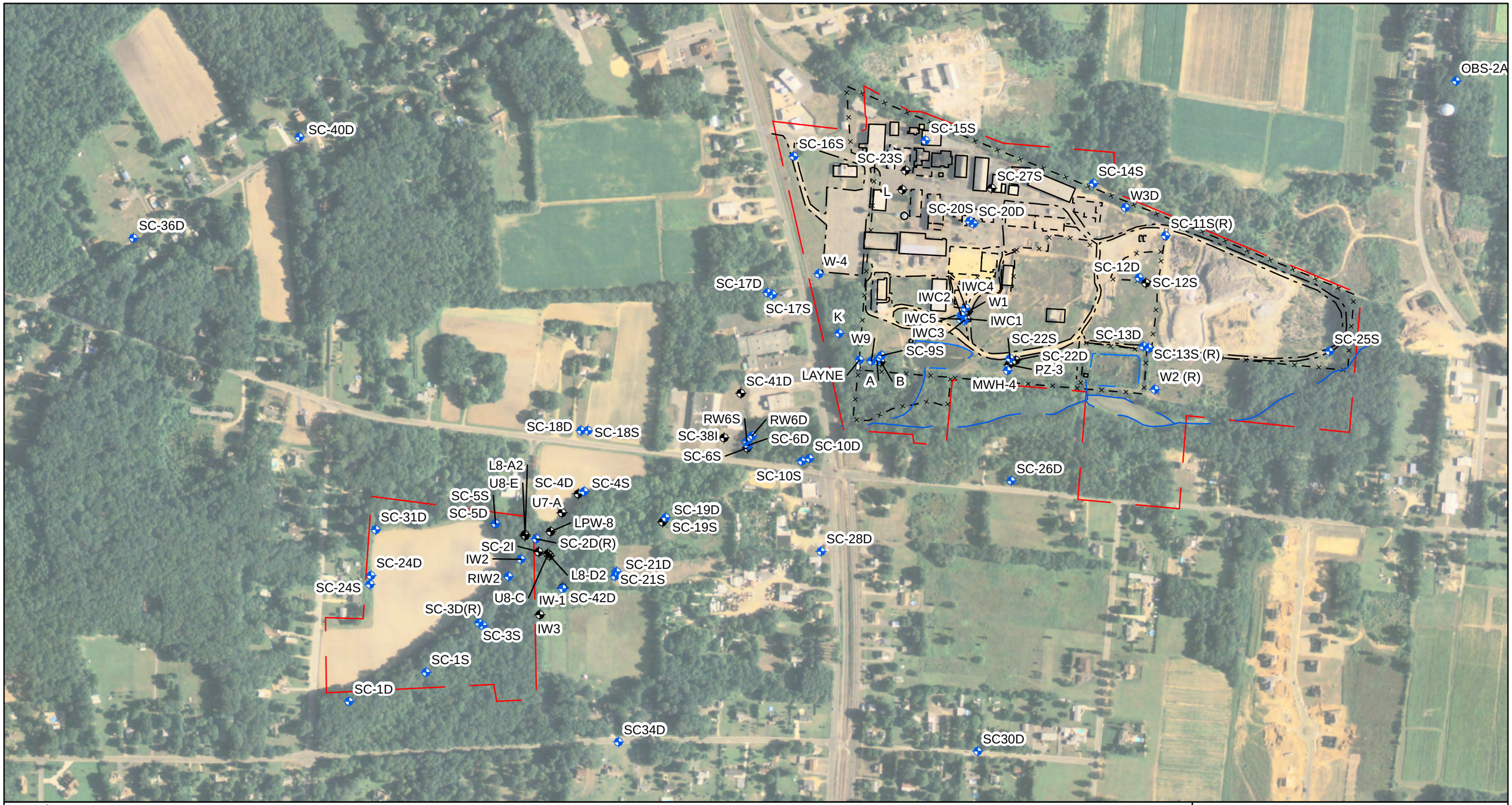
Sheildalloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

Blue Bell, PA | May 2019

Figure 3

P:\GIS\GISprojects\JR0241 - Sheildalloy\Projects\Fig 3 - Vertical Borings and Related Monitoring Wells.mxd 4/16/2019 1:45:44 PM



Legend

- Site Property Boundary
- Current Building
- Demolished Building
- Fence Line
- Pond
- Road
- Gate
- Fence Line
- Water Feature
- Monitoring Wells included in Sampling Plan
- Monitoring Wells not included in Sampling Plan

Notes:
The information in this figure is based on TRC Figure 2-2 from the 2011 OU3 Perchlorate Site Characterization Summary Report.

N

0 460 Feet

On-Site and Off-Site Monitoring Wells

Sheildalloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

Blue Bell, PA | May 2019

Figure 4

P:\GIS\GISprojects\JR0241 - Sheildalloy\Projects\Fig 1 - On-Site and Off Site Monitoring Wells.mxd 4/16/2019 1:58:59 PM

Legend

- Site Property Boundary
- Current Building
- Demolished Building
- Fence Line
- Pond
- Road
- Gate
- Fence Line
- Water Feature
- Monitoring Wells included in Sampling Plan
- Monitoring Wells not included in Sampling Plan

Notes:
The information in this figure is based on TRC Figure 2-3 from the 2011 OU3 Perchlorate Site Characterization Summary Report.

N

0 1,120 Feet

Off-Site Monitoring Wells

Sheildalloy Metallurgical Corporation
Newfield, New Jersey

Geosyntec consultants

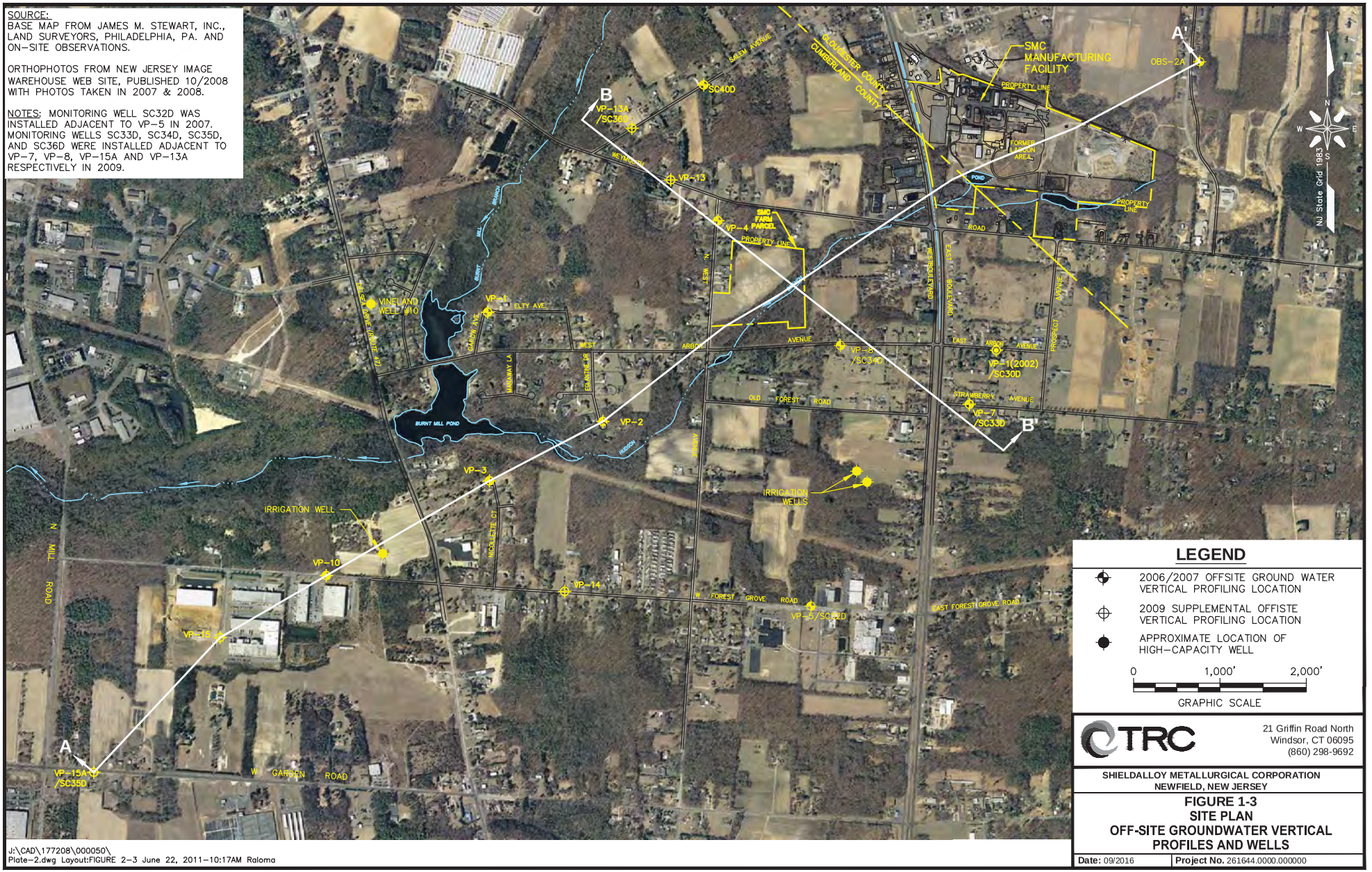
Blue Bell, PA | May 2019

Figure 5

P:\GIS\GISprojects\JR0241 - Sheildalloy\Projects\Fig 2 - Off Site Monitoring Wells.mxd 4/16/2019 2:22:07 PM

APPENDIX A

Perchlorate Concentration Isopleths and Cross Sections



LEGEND

- 2006/2007 OFFSITE GROUND WATER VERTICAL PROFILING LOCATION
- 2009 SUPPLEMENTAL OFFISTE VERTICAL PROFILING LOCATION
- APPROXIMATE LOCATION OF HIGH-CAPACITY WELL

0 1,000' 2,000'

GRAPHIC SCALE

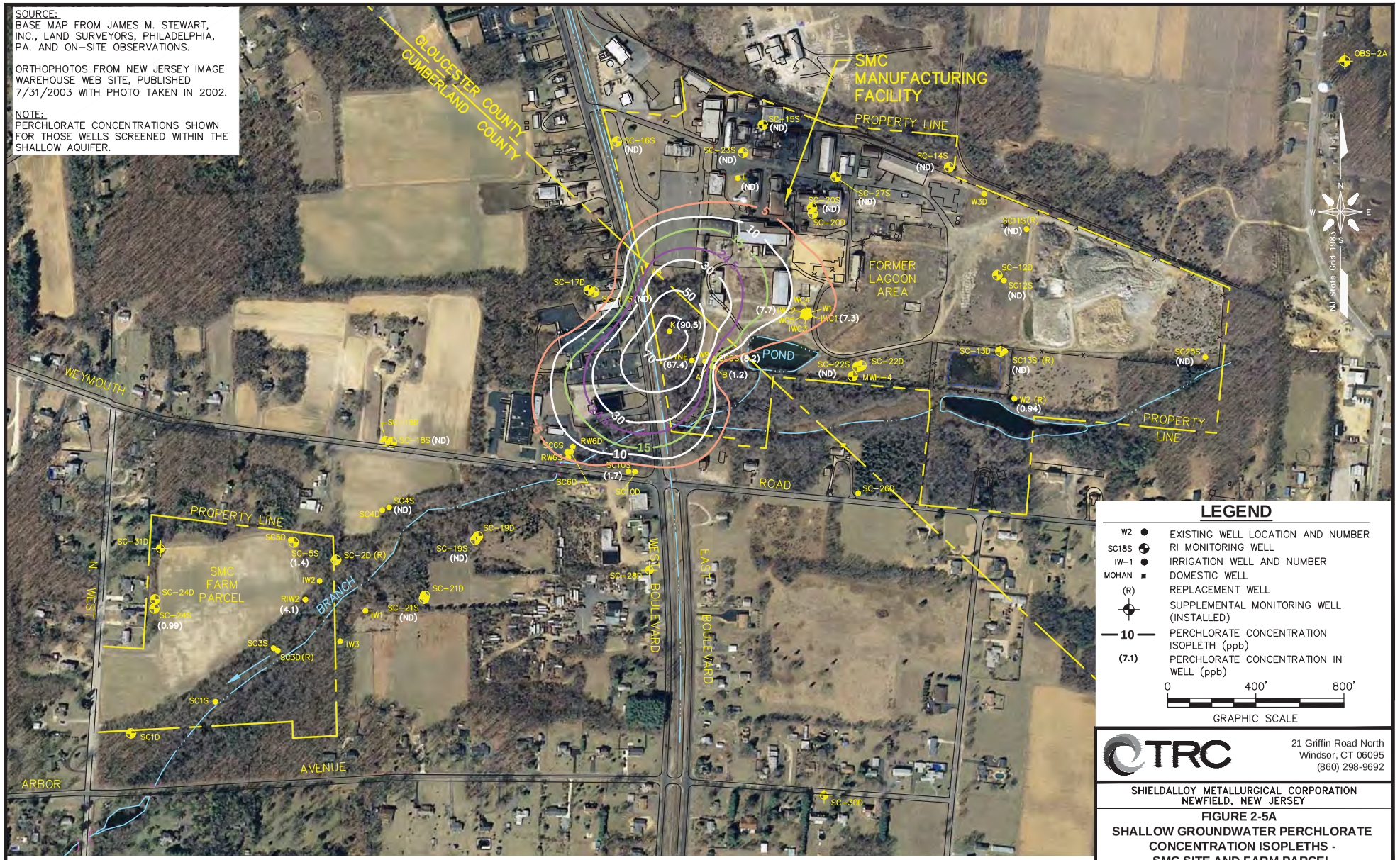
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 1-3
SITE PLAN
OFF-SITE GROUNDWATER VERTICAL PROFILES AND WELLS

Date: 09/2016 | **Project No.** 261644.0000.000000

J:\CAD\177208\000050\
Plate-2.dwg Layout:FIGURE 2-3 June 22, 2011-10:17AM Raloma

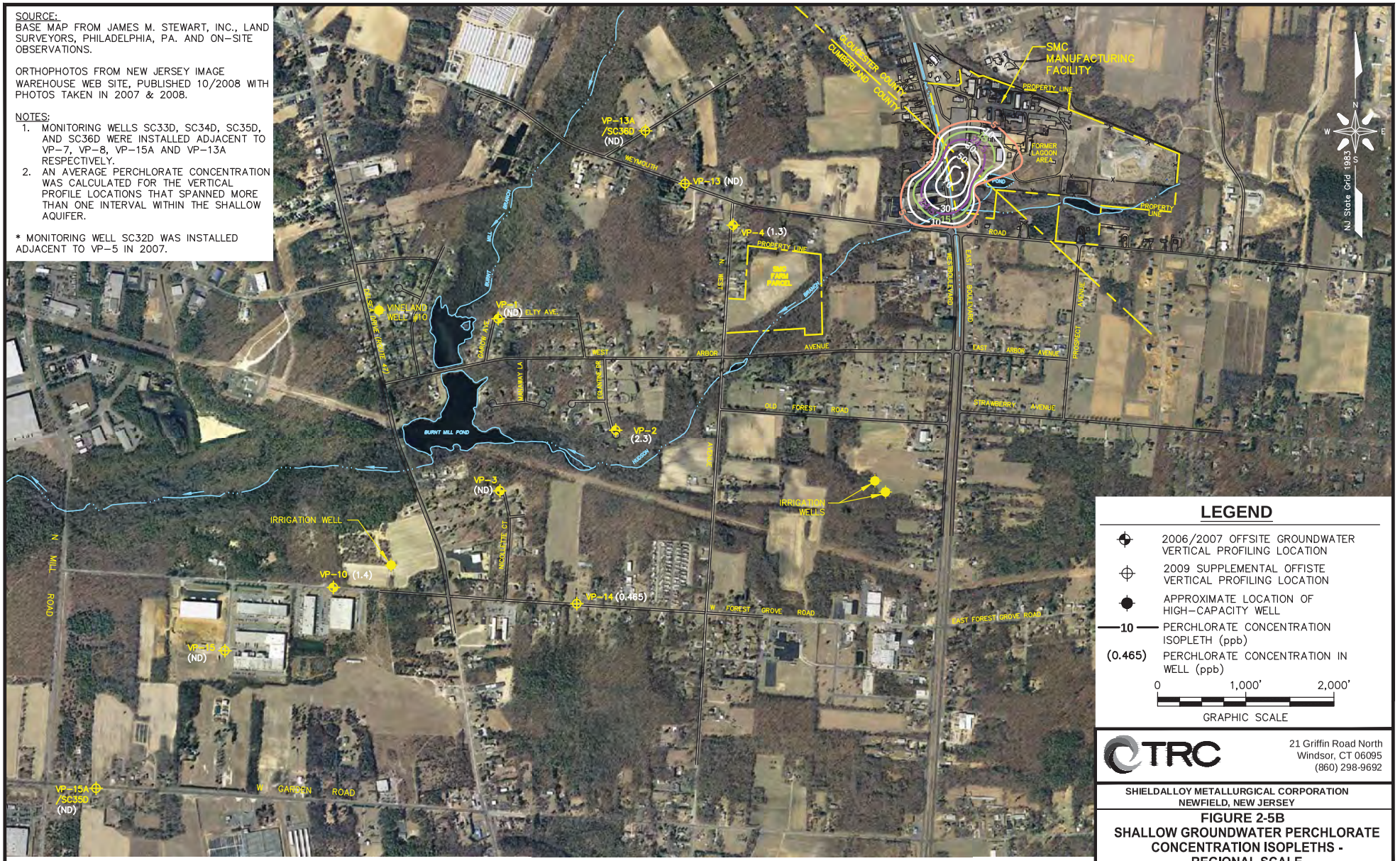

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.
ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 7/31/2003 WITH PHOTO TAKEN IN 2002.
NOTE:
PERCHLORATE CONCENTRATIONS SHOWN FOR THOSE WELLS SCREENED WITHIN THE SHALLOW AQUIFER.
GLOUCESTER COUNTY
CUMBERLAND COUNTY
SMC MANUFACTURING FACILITY
PROPERTY LINE
FORMER LAGOON AREA
POND
WEYMOUTH
ROAD
SMC FARM PARCEL
PROPERTY LINE
N. WEST BRANCH
WEST BOULEVARD
EAST BOULEVARD
ARBOR AVENUE
SC-15S (ND)
SC-16S (ND)
SC-23S (ND)
SC-14S (ND)
SC-27S (ND)
SC-20S (ND)
SC-20D
SC-17D
SC-17S (ND)
SC-12D
SC12S (ND)
SC-13D
SC13S (R) (ND)
SC25S (ND)
SC-22S (ND)
SC-22D
MW1-4
SC-18D
SC-18S (ND)
SC6S
RW6D
RW6S
SC10S (1.7)
SC6D
SC10D
SC-26D
SC4S (ND)
SC4D
SC-19D
SC-19S (ND)
SC5D
SC-5S (1.4)
SC-2D (R)
SC-31D
SC-24D
SC-24S (0.99)
IW2
RIW2 (4.1)
IW1
SC-21D
SC-21S (ND)
SC-28D
SC3S
SC3D(R)
IW3
SC1S
SC1D
SC-30D
OBS-2A
W3D
SC15D(R) (ND)
W2 (R) (0.94)
W1
IWC1 (7.3)
IWC2
IWC3
(7.7)
K (90.5)
LINE (67.4)
B (1.2)
(3.2)
A
10
30
50
70
90
30
15
10
5
NJ State Grid 1983
N
S
E
W
LEGEND
W2 EXISTING WELL LOCATION AND NUMBER
SC18S RI MONITORING WELL
IW-1 IRRIGATION WELL AND NUMBER
MOHAN DOMESTIC WELL
(R) REPLACEMENT WELL
SUPPLEMENTAL MONITORING WELL (INSTALLED)
10 PERCHLORATE CONCENTRATION ISOPLETH (ppb)
(7.1) PERCHLORATE CONCENTRATION IN WELL (ppb)
0 400' 800'
GRAPHIC SCALE
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692
SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY
FIGURE 2-5A
SHALLOW GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - SMC SITE AND FARM PARCEL
Date: 09/2016
Project No. 261644.0000.000000
J:\CAD\171441\000050\Remedial Inv Report\
Plate-1.dwg Layout:FIGURE 10-1A November 19, 2010-1:32PM KHollenbeck

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 10/2008 WITH PHOTOS TAKEN IN 2007 & 2008.

NOTES:
1. MONITORING WELLS SC33D, SC34D, SC35D, AND SC36D WERE INSTALLED ADJACENT TO VP-7, VP-8, VP-15A AND VP-13A RESPECTIVELY.
2. AN AVERAGE PERCHLORATE CONCENTRATION WAS CALCULATED FOR THE VERTICAL PROFILE LOCATIONS THAT SPANNED MORE THAN ONE INTERVAL WITHIN THE SHALLOW AQUIFER.

* MONITORING WELL SC32D WAS INSTALLED ADJACENT TO VP-5 IN 2007.



LEGEND

- 2006/2007 OFFSITE GROUNDWATER VERTICAL PROFILING LOCATION
- 2009 SUPPLEMENTAL OFFISTE VERTICAL PROFILING LOCATION
- APPROXIMATE LOCATION OF HIGH-CAPACITY WELL
- 10 — PERCHLORATE CONCENTRATION ISOPLETH (ppb)
- (0.465) PERCHLORATE CONCENTRATION IN WELL (ppb)

0 1,000' 2,000'

GRAPHIC SCALE

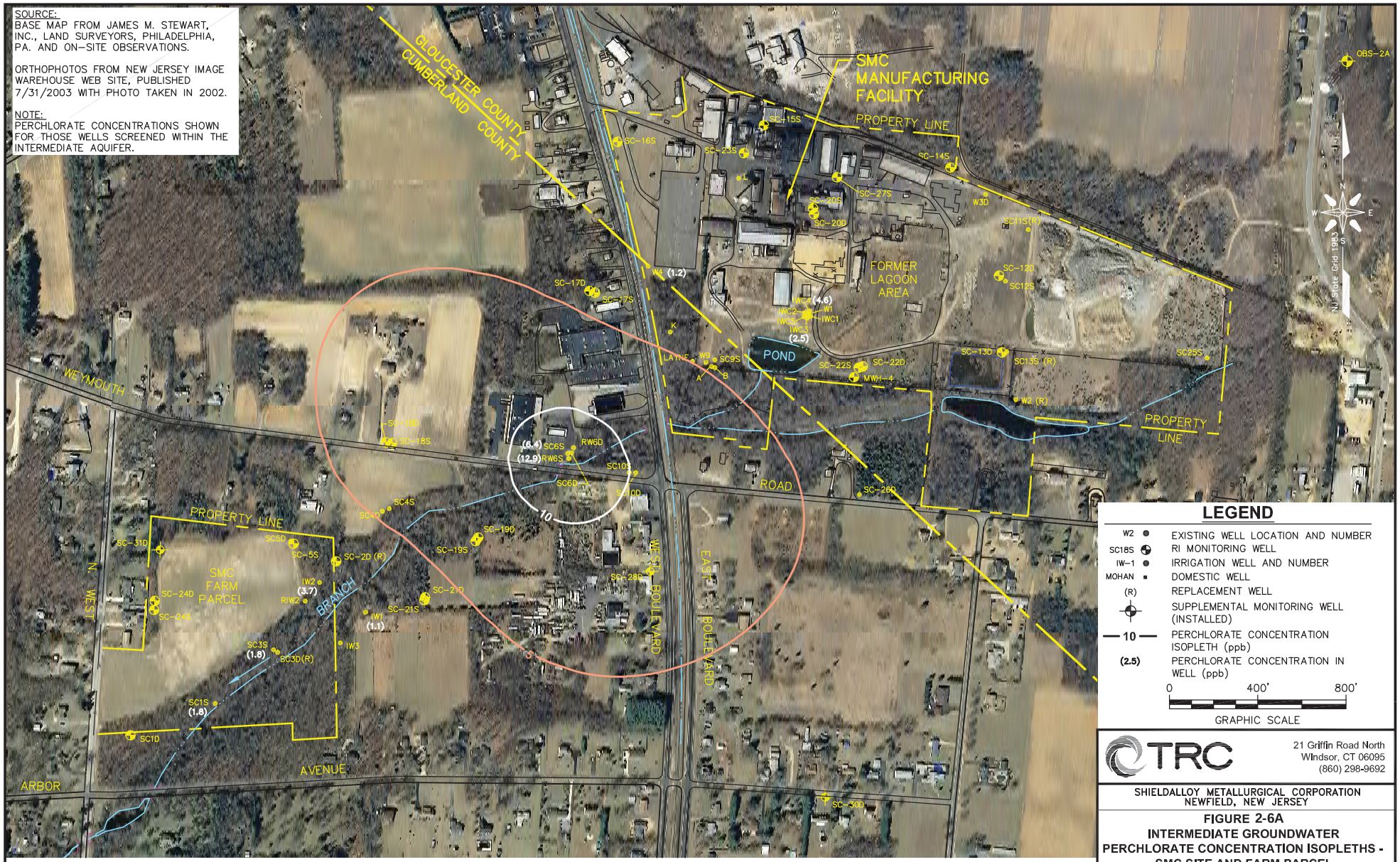
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 2-5B
SHALLOW GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - REGIONAL SCALE

Date: 09/2016 | **Project No.** 261644.0000.000000

J:\CAD\171441\000050\Remedial Inv Report\
Plate-4.dwg Layout:FIGURE 10-1B November 19, 2010-1:40PM KHollenbeck



J:\CAD\171441\000050\Remedial Inv Report\
Plate-1.dwg Layout:FIGURE 10-2A March 15, 2010-10:27AM KHollenbeck

TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 2-6A
INTERMEDIATE GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - SMC SITE AND FARM PARCEL

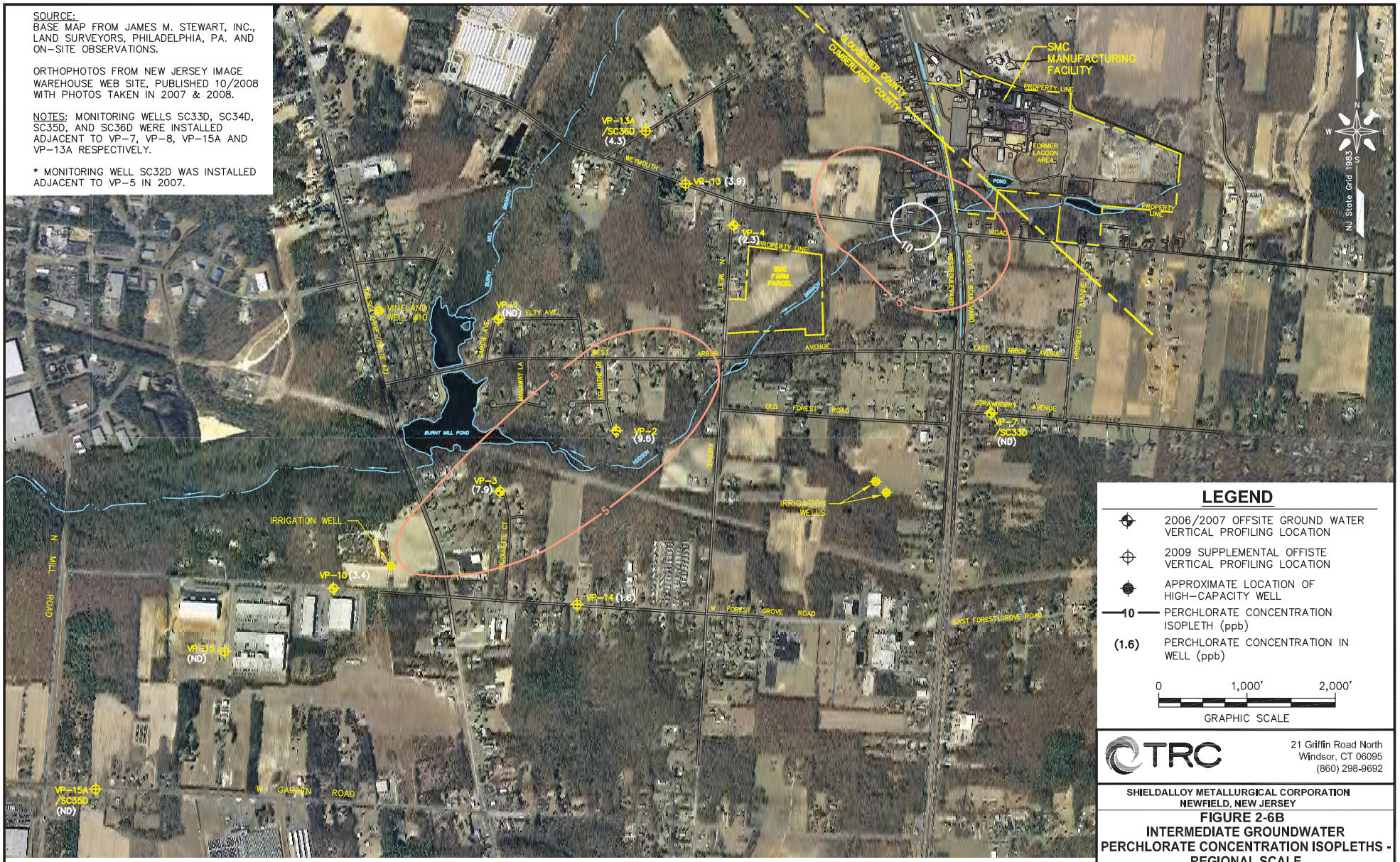
Date: 09/2016 **Project No.** 261644.0000.000000

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 10/2008 WITH PHOTOS TAKEN IN 2007 & 2008.

NOTES: MONITORING WELLS SC33D, SC34D, SC35D, AND SC36D WERE INSTALLED ADJACENT TO VP-7, VP-8, VP-15A AND VP-13A RESPECTIVELY.

* MONITORING WELL SC32D WAS INSTALLED ADJACENT TO VP-5 IN 2007.



LEGEND

- 2006/2007 OFFSITE GROUND WATER VERTICAL PROFILING LOCATION
- 2009 SUPPLEMENTAL OFFISTE VERTICAL PROFILING LOCATION
- APPROXIMATE LOCATION OF HIGH-CAPACITY WELL
- 10 — PERCHLORATE CONCENTRATION ISOPLETH (ppb)
- (1.6) PERCHLORATE CONCENTRATION IN WELL (ppb)

0 1,000' 2,000'

GRAPHIC SCALE

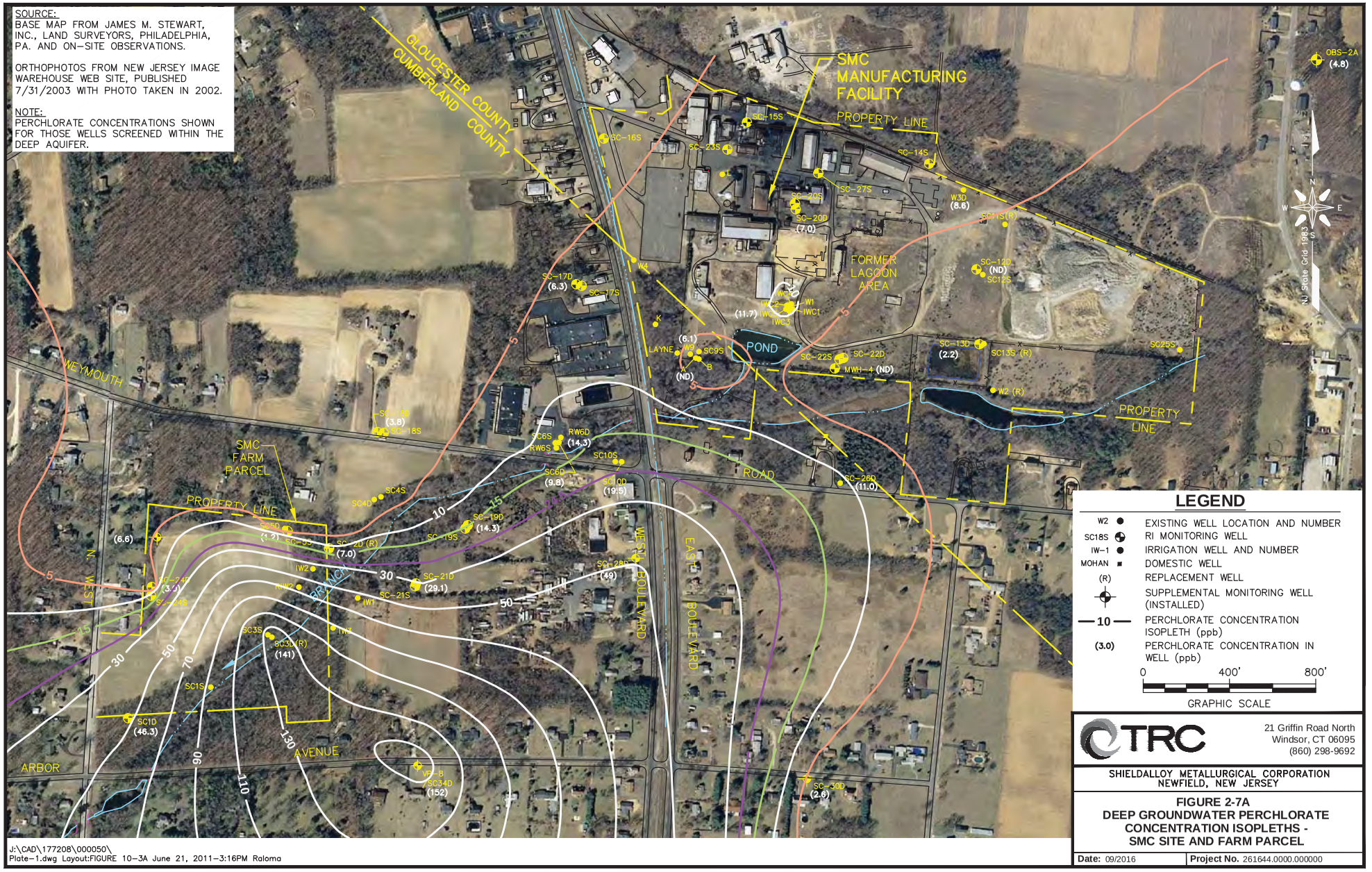
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 2-6B
INTERMEDIATE GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - REGIONAL SCALE

Date: 09/2016 | Project No. 261644.0000.000000

J:\CAD\171441\000050\Remedial Inv Report\
Plate-4.dwg Layout:FIGURE 10-2B March 15, 2010-10:15AM KHollenbeck

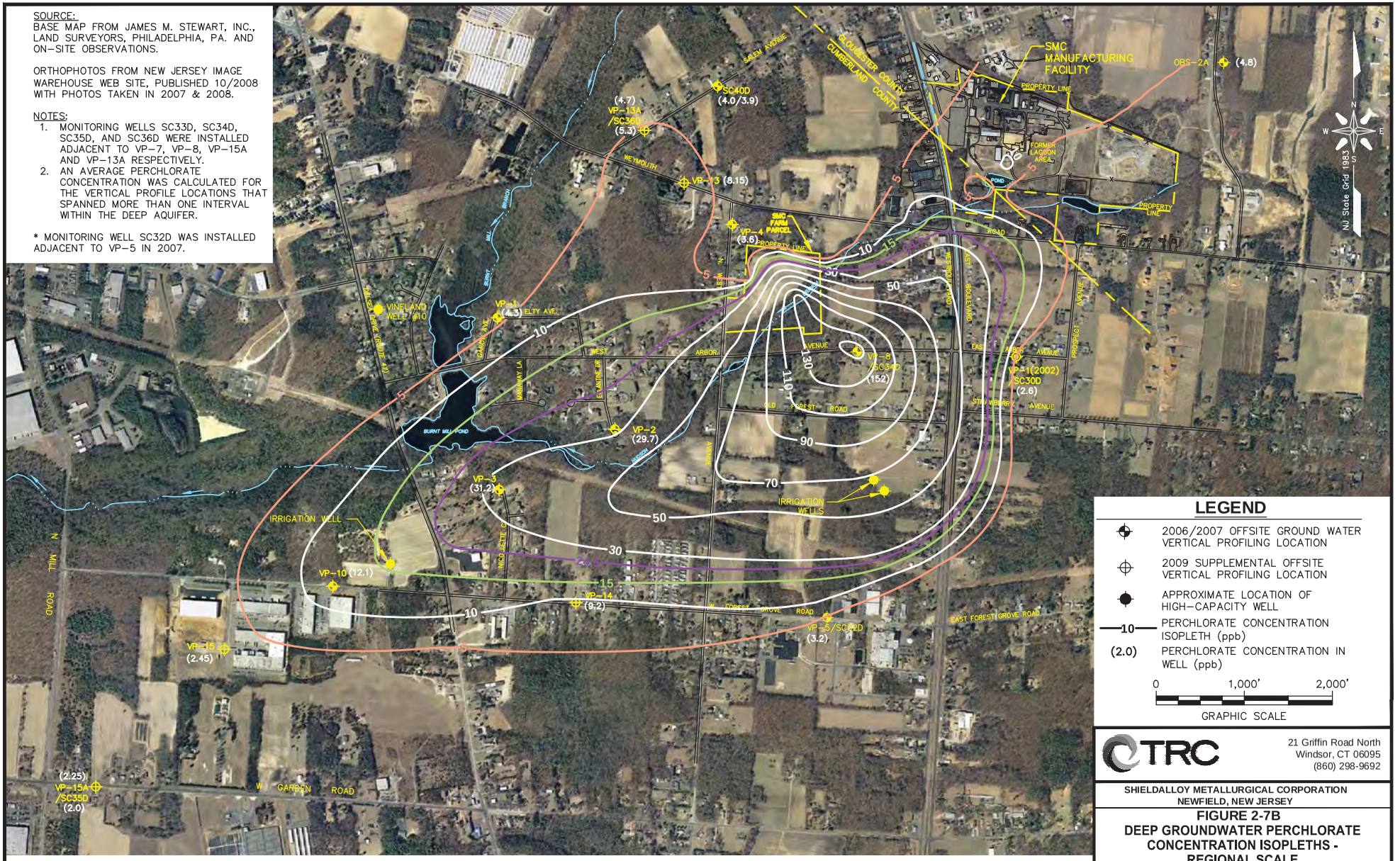

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.
ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 7/31/2003 WITH PHOTO TAKEN IN 2002.
NOTE:
PERCHLORATE CONCENTRATIONS SHOWN FOR THOSE WELLS SCREENED WITHIN THE DEEP AQUIFER.
GLOUCESTER COUNTY
CUMBERLAND COUNTY
SMC MANUFACTURING FACILITY
PROPERTY LINE
FORMER LAGOON AREA
POND
WEYMOUTH
SMC FARM PARCEL
PROPERTY LINE
ROAD
WEST BRANCH
WEST BOULEVARD
EAST BOULEVARD
ARBOR AVENUE
N
W
E
S
NJ State Grid 1983
LEGEND
W2 EXISTING WELL LOCATION AND NUMBER
SC18S RI MONITORING WELL
IW-1 IRRIGATION WELL AND NUMBER
MOHAN DOMESTIC WELL
(R) REPLACEMENT WELL
SUPPLEMENTAL MONITORING WELL (INSTALLED)
10 PERCHLORATE CONCENTRATION ISOPLETH (ppb)
(3.0) PERCHLORATE CONCENTRATION IN WELL (ppb)
0 400' 800'
GRAPHIC SCALE
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692
SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY
FIGURE 2-7A
DEEP GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS -
SMC SITE AND FARM PARCEL
Date: 09/2016
Project No. 261644.0000.000000
J:\CAD\177208\000050\
Plate-1.dwg Layout:FIGURE 10-3A June 21, 2011-3:16PM Raloma

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 10/2008 WITH PHOTOS TAKEN IN 2007 & 2008.

NOTES:
1. MONITORING WELLS SC33D, SC34D, SC35D, AND SC36D WERE INSTALLED ADJACENT TO VP-7, VP-8, VP-15A AND VP-13A RESPECTIVELY.
2. AN AVERAGE PERCHLORATE CONCENTRATION WAS CALCULATED FOR THE VERTICAL PROFILE LOCATIONS THAT SPANNED MORE THAN ONE INTERVAL WITHIN THE DEEP AQUIFER.

* MONITORING WELL SC32D WAS INSTALLED ADJACENT TO VP-5 IN 2007.



LEGEND

- 2006/2007 OFFSITE GROUND WATER VERTICAL PROFILING LOCATION
- 2009 SUPPLEMENTAL OFFSITE VERTICAL PROFILING LOCATION
- APPROXIMATE LOCATION OF HIGH-CAPACITY WELL
- 10 — PERCHLORATE CONCENTRATION ISOPLETH (ppb)
- (2.0) PERCHLORATE CONCENTRATION IN WELL (ppb)

0 1,000' 2,000'
GRAPHIC SCALE

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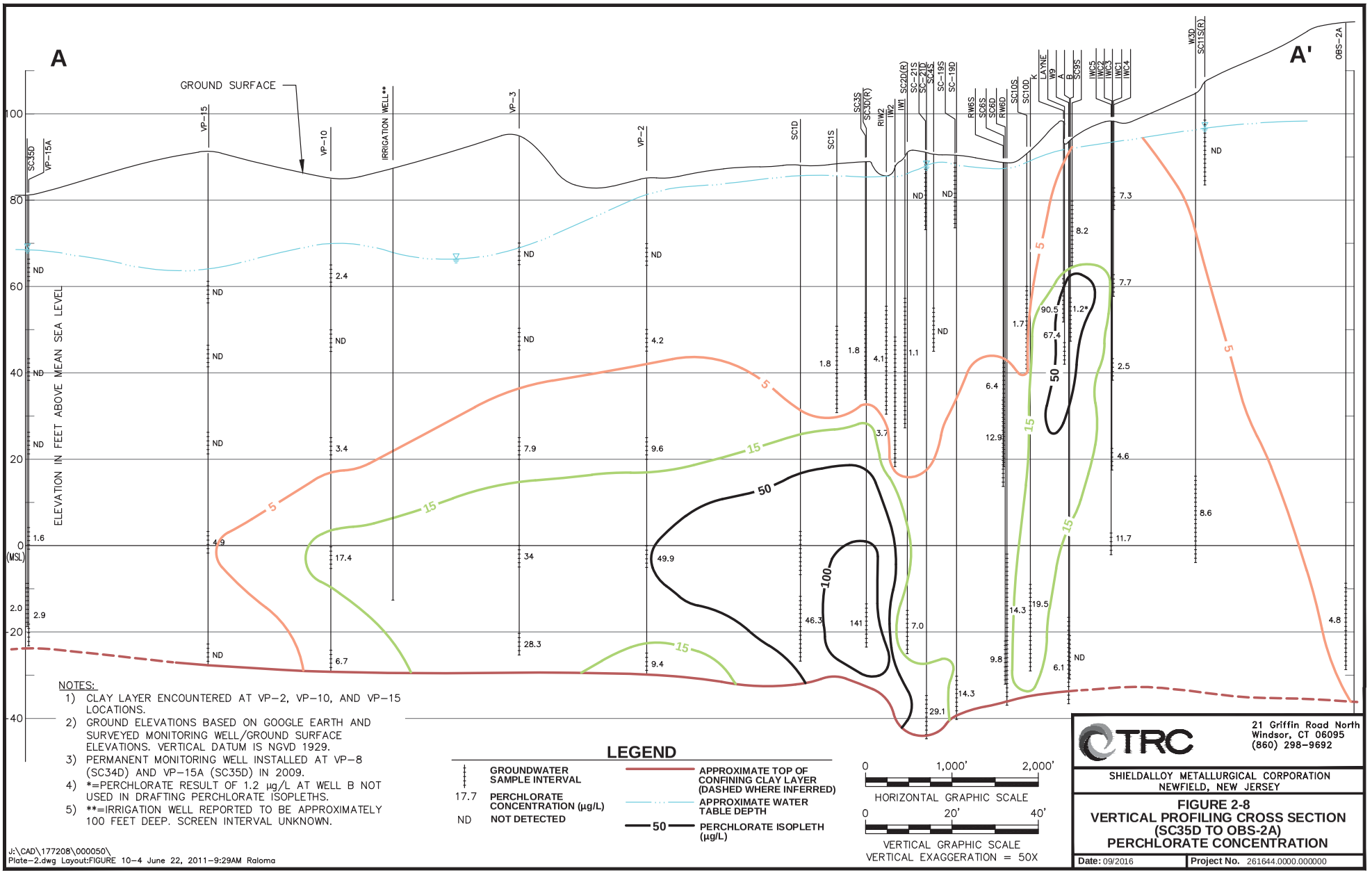
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 2-7B
DEEP GROUNDWATER PERCHLORATE CONCENTRATION ISOPLETHS - REGIONAL SCALE

Date: 09/2016 | **Project No.** 261644.0000.000000

J:\CAD\177208\000050\
Plate-2.dwg Layout:FIGURE 10-3B June 21, 2011-3:18PM Raloma



NOTES:

1) CLAY LAYER ENCOUNTERED AT VP-2, VP-10, AND VP-15 LOCATIONS.
2) GROUND ELEVATIONS BASED ON GOOGLE EARTH AND SURVEYED MONITORING WELL/GROUND SURFACE ELEVATIONS. VERTICAL DATUM IS NGVD 1929.
3) PERMANENT MONITORING WELL INSTALLED AT VP-8 (SC34D) AND VP-15A (SC35D) IN 2009.
4) *=PERCHLORATE RESULT OF 1.2 µg/L AT WELL B NOT USED IN DRAFTING PERCHLORATE ISOPLETHS.
5) **=IRRIGATION WELL REPORTED TO BE APPROXIMATELY 100 FEET DEEP. SCREEN INTERVAL UNKNOWN.

LEGEND

- GROUNDWATER SAMPLE INTERVAL
- 17.7 PERCHLORATE CONCENTRATION (µg/L)
- ND NOT DETECTED
- APPROXIMATE TOP OF CONFINING CLAY LAYER (DASHED WHERE INFERRED)
- APPROXIMATE WATER TABLE DEPTH
- 50 PERCHLORATE ISOPLETH (µg/L)

0 1,000' 2,000'
HORIZONTAL GRAPHIC SCALE

0 20' 40'
VERTICAL GRAPHIC SCALE
VERTICAL EXAGGERATION = 50X

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21 Griffin Road North
Windsor, CT 06095
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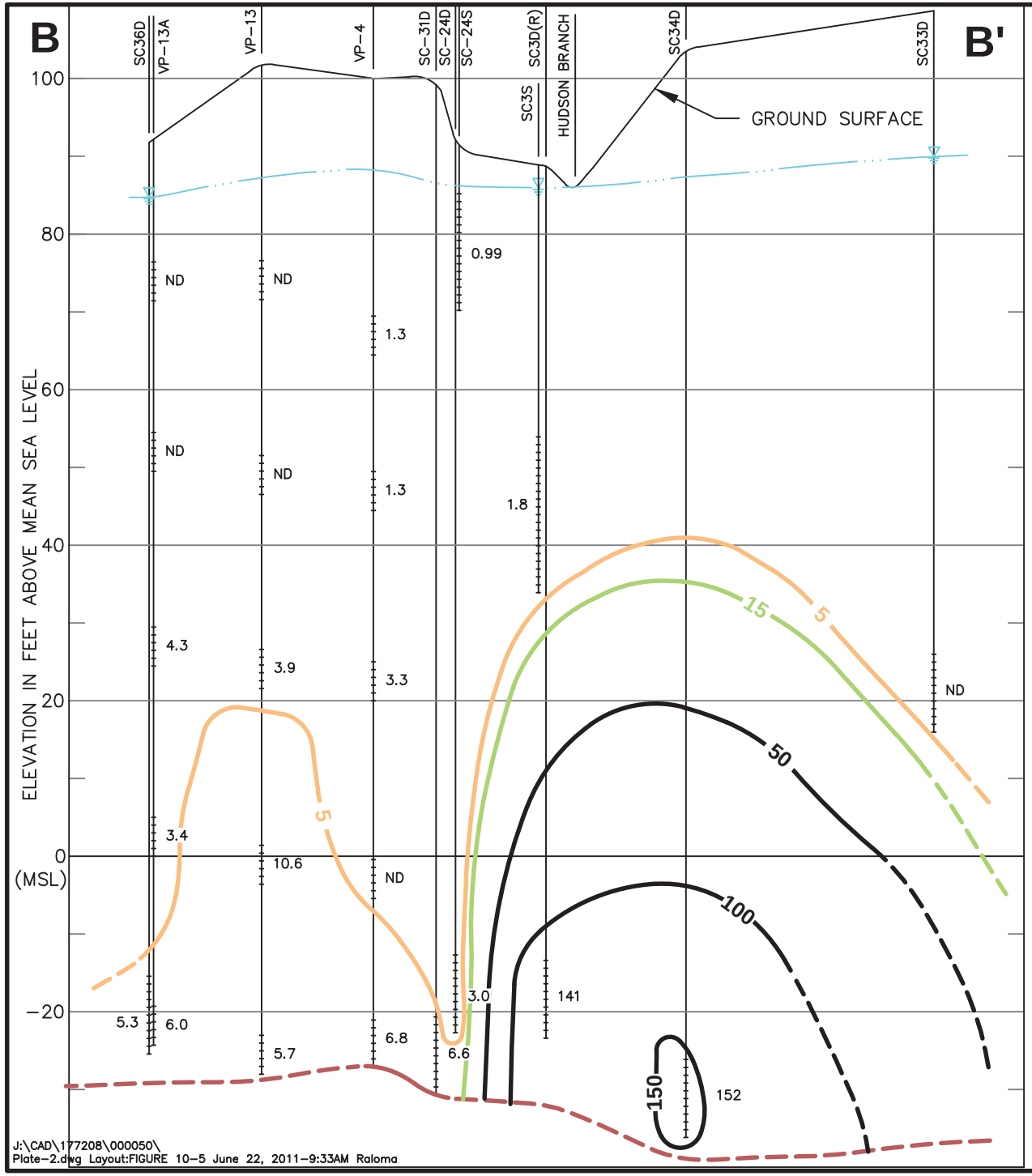
NEWFIELD, NEW JERSEY

FIGURE 2-8
VERTICAL PROFILING CROSS SECTION (SC35D TO OBS-2A) PERCHLORATE CONCENTRATION

Date: 09/2016 | Project No. 261644.0000.000000

J:\CAD\177208\000050\
Plate-2.dwg Layout:FIGURE 10-4 June 22, 2011-9:29AM Raloma



LEGEND

- APPROXIMATE TOP OF CONFINING CLAY LAYER (DASHED WHERE INFERRED)
- APPROXIMATE WATER TABLE DEPTH
- 50 — PERCHLORATE ISOPLETH (µg/L) (DASHED WHERE INFERRED)
- GROUNDWATER SAMPLE INTERVAL
- 17.7 — PERCHLORATE CONCENTRATION (µg/L)
- ND — NOT DETECTED

NOTES:

1) CLAY LAYER ENCOUNTERED AT VP-4 AND SC31D LOCATIONS.
2) GROUND ELEVATIONS BASED ON GOOGLE EARTH AND SURVEYED MONITORING WELL/GROUND SURFACE ELEVATIONS. VERTICAL DATUM IS NGVD 1929.
3) PERMANENT MONITORING WELLS INSTALLED AT VP-7 (SC33D) AND VP-8 (SC34D) IN 2009.

0 1,000' 2,000'

HORIZONTAL GRAPHIC SCALE

0 20' 40'

VERTICAL GRAPHIC SCALE
VERTICAL EXAGGERATION = 50X

TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 2-9
VERTICAL PROFILING CROSS SECTION (SC36D TO SC33D) PERCHLORATE CONCENTRATION

Date: 09/2016 | **Project No.** 261644.0000.000000

J:\CAD\177208\000050\Plate-2.dwg Layout:FIGURE 10-5 June 22, 2011-9:33AM Raloma

APPENDIX B
QAPP Worksheets

Geosyntec consultants

TABLE OF CONTENTS

QAPP WORKSHEET #1: TITLE AND APPROVAL PAGE

QUALITY ASSURANCE PROJECT PLAN

Shieldalloy Metallurgical Corporation Superfund Site
Operable Unit 3
Perchlorates

Prepared by:

Geosyntec consultants
engineers | scientists | innovators

7 Graphics Drive
Suite 106
Ewing Township, New Jersey 08628
(609) 895-1400

Review Signatures: _____

John Persico, P.G. / Date: _____
Project Director– Geosyntec

_____
Seth Kellogg / Date: _____
Project Manager – Geosyntec

Approval Signatures: _____

Remedial Project Manager – USEPA Region 2

QAPP WORKSHEET #3: DISTRIBUTION LIST

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
John Persico	Project Director	Geosyntec	(609) 895-1400	JPersico@geosyntec.com
John Hunt	Director of Environmental Projects	Shieldalloy	(484) 582-3519	jhunt@amg-nv.com
Sherrel Henry	Remediation Project Manager	EPA	212-637-4273	henry.sherrel@epa.gov
Seth Kellogg	Project Manager	Geosyntec	(609) 895-1400	SKellogg@geosyntec.com
Dale Prokopchak	Corporate Health and Safety Officer	Geosyntec	(804) 665-2811	DProkopchak@geosyntec.com
Livia Capaldi	Project QA Manager	Geosyntec	(609) 895-1400	LCapaldi@geosyntec.com
Jessica Evans	Field Manager/ Project EHS Officer	Geosyntec	(609) 895-1400	JEvans@geosyntec.com
Mary Tyler	Analytical Data QA Manager	Geosyntec	(865) 291-4699	MTyler@geosyntec.com
Elizabeth Bauer	Laboratory Project Manager	Eurofins Lancaster Laboratories Environmental, LLC	(717) 556-7290	ElizabethMBauer@eurofinsUS.com
Neil Sturchio	Laboratory Director	Environmental Isotope Geochemistry Laboratory: University of Delaware	(302) 831-8706	Sturchio@udel.com

QAPP WORKSHEET #4: PROJECT PERSONNEL SIGN-OFF SHEET

Project Personnel	Organization/Title/Role	Telephone Number	Signature*	Date QAPP Read
Seth Kellogg	Geosyntec/Project Manager	(609) 895-1400		

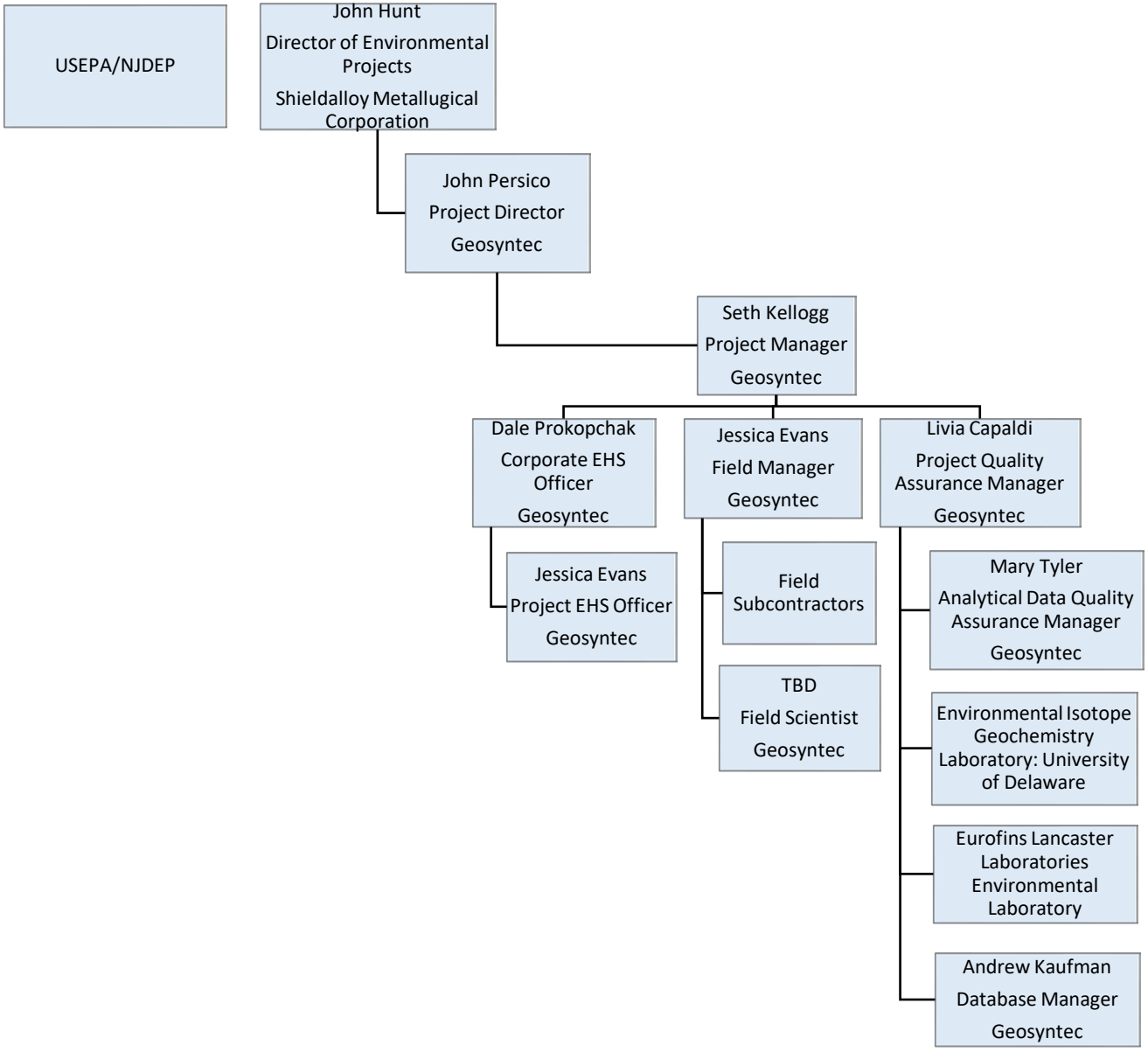
* Signature indicates personnel have read applicable QAPP sections and will perform the work as indicated herein.

Note: Additional sheets will be signed by Geosyntec field scientists and field technicians and these signatures will be maintained in the project file.

QAPP WORKSHEET #4: PROJECT PERSONNEL SIGN -OFF SHEET (CONTINUED)

Field Personnel	Organization/Title/Role	Signature*	Date QAPP Read

QAPP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART



QAPP WORKSHEET #6: COMMUNICATION PATHWAYS

Communication Drivers	Responsible Affiliation	Role	Contact Information	Procedure
Approval of Amendments to QAPP	Geosyntec	Project Manager	See Worksheet #3 and #4	Obtain initial approval from Project Manager. Submit documented amendments within 10 working days for transmittal to the Respondent's Representative for submission to the EPA RPM for approval.
Approval of activities deviating from QAPP	Geosyntec	Project Manager	See Worksheet #3 and #4	Obtain initial approval from Project Manager. Submit request for deviation within 10 working days for transmittal to the Respondent's Representative for submission to the EPA Remedial Project Manager for approval.
Document Control	Geosyntec	Project Manager Project QA Manager	See Worksheet #3 and #4	The reports and formal correspondence will be reviewed by Project Manager prior to transmittal to the Respondent's Representative for submission to the EPA. Documents with analytical data prepared for submittal to EPA will be reviewed by the Project QA Manager or their designee prior to submittal to the Respondent's Representative for submission to the EPA
Stop work and initiation of stop work procedure	Geosyntec	Field Manager Project EHS Officer	See Worksheet #3 and #4	All field personnel will have stop work authority if an unsafe condition is encountered. All stop work occurrences will be reported to the EHS Officer and the EHS Officer will forward this information on to the Project Manager using telephone and/or email as soon as possible.
Work Stoppages	Geosyntec	Project Manager Field Manager Project EHS Officer	See Worksheet #3 and #4	The Project Manager will communicate work stoppages to the project organization within 24 hours.

QAPP WORKSHEET #6: COMMUNICATION PATHWAYS (CONTINUED)

Communication Drivers	Responsible Affiliation	Role	Contact Information	Procedure
Real time modifications, notifications, and approvals	Geosyntec	Field Manager	See Worksheet #3 and #4	Real-time modifications to the project will require the approval of the Project Manager, the Respondent's Representative and the EPA Remedial Project Manager and will be documented within 5 working days.
Reporting of health and safety issues	Geosyntec	Project EHS Officer Field Manager	See Worksheet #3 and #4	H&S issues involving an injury, a stop work procedure, a "good catch," or a condition that may result in an incident must be reported to the EHS Officer immediately. The EHS Officer will forward this information on to the Project Manager using telephone and email as soon as possible. The Project Manager will notify the Respondent's Representative and EPA Remedial Project Manager of any serious health and safety incident/issue within 24 hours of occurrence. Non-serious incidents/issues may be forwarded from the Project Manager to the Respondent's Representative and who may submit to the EPA Remedial Project Manager on a monthly basis within the monthly progress reports.
Reporting of issues related to AOC requirements.	Geosyntec	Project Manager	See Worksheet #3 and #4	Issues that prevent the collection of usable data will be reported to the Respondent Project Manager immediately.
Real time changes to sample collection or analysis procedures	Geosyntec	Field Manager Project QA Manager	See Worksheet #3 and #4	Conditions requiring variation to sampling and analysis procedures will be reported to the Field Manager within 24 hours of the condition requiring the modification. The Field Manager or Project QA Manager will report the variations to the Project Manager as appropriate.

QAPP WORKSHEET #6: COMMUNICATION PATHWAYS (CONTINUED)

Communication Drivers	Responsible Affiliation	Role	Contact Information	Procedure
Reporting issues related to data quality, including the inability to meet reporting limits	Eurofins	Laboratory PM	See Worksheet #3 and #4	Problems with the data quality will be reported to the Project Manager and Project QA Manager within 24 hours of laboratory results.
Data validation issues	Geosyntec	Analytical Data QA Manager	See Worksheet #3 and #4	Problems with data quality or data validation will be reported to the Project Manager and the QA Manager within 24 hours of the identification of the data validation issue.
Data Review Corrective Action	Geosyntec	Analytical Data QA Manager or designee	See Worksheet #3 and #4	Corrective Action Subjects: • Field Sampling Procedure • Offsite Laboratory Technical Systems Audit • Offsite Laboratory Technical Systems Audit: Laboratory Personnel • Data Quality Assessment

QAPP WORKSHEET #7: PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

Name	Project Title/Role	Organizational Affiliation	Responsibilities	Education and/or Experience Qualifications
Sherrel Henry	Remedial Project Manager	EPA Region 2	Remedial Project Manager	
John Persico	Project Director	Geosyntec		M.S. Geology, P.G.
Seth Kellogg	Project Manger	Geosyntec	Project Administration & Technical Oversight	M.S. Geology, P.G.
Dale Prokopchak	Health and Safety Manager	Geosyntec	Corporate health and safety management	CIH, CSP
Mary Tyler	Analytical Data Quality Assurance Manager	Geosyntec	Data validation	M.S. Engineering
Jessica Evans	Project EHS Officer and Field Manager	Geosyntec	Site health and safety and manage field staff	M.S. Biology
Livia Capaldi	Project QA Manager	Geosyntec	Project quality assurance	M.S. Geology
Elizabeth Bauer	Laboratory Project Manager	Eurofins Lancaster Laboratories Environmental	Point of contact with Geosyntec, resolve sampling, receipt, analysis and storage issues.	
Neil Sturchio	Laboratory Director	Environmental Isotope Geochemistry Laboratory: University of Delaware	Point of contact with Geosyntec, resolve sampling, receipt, analysis and storage issues.	Ph.D. Earth and Planetary Sciences

QAPP WORKSHEET #8: SPECIALIZED PERSONNEL TRAINING REQUIREMENTS TABLE

Project Function	Specialized Training by Title or Description of Course	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Sample Collection	40-Hour HAZWOPER Training	Field Personnel	Geosyntec	Footnote 1
SOP-specific	Project-specific SOP training	Personnel as required	Geosyntec	Field Site

1. Documentation for training is maintained at home office of employee and is available upon request

QAPP WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY

The following is a summary of Project Planning sessions that have occurred:

Date of Planning Session: 3/22/2019
Location: Shieldalloy Site
Purpose: Discuss project overview & technical approach

Attendees and Role:

Name	Organization	Title/ Role	Email
Jessica Evans	Geosyntec	Staff Scientist	jmevans@geosyntec.com
Sherrel Henry	EPA	Remedial Project Manager	Henry.sherrel@epa.gov
John Hunt	SMC	Respondent Project Manager	jhunt@amg-nv.com
Katherine DeLuca	EPA/ CRC	Attorney	Deluca.katherine@epa.gov
Rachel Griffiths	EPA	Hydrogeologist	Griffiths.rachel@epa.gov
Donna L. Gaffigan	NJDEP	NJDEP Case Manager	Donna.gaffigan@DEP.NJ.GOV
Seth Kellogg	Geosyntec	Project Manager	skellogg@geosyntec.com
John Persico	Geosyntec	Project Director	jpersico@geosyntec.com

Notes/Comments: Wells designated as background will need evidence to support that they are background. Several rounds of sampling will be needed to support MNA if that approach is selected

Consensus decisions made: Project planning documents and approach are acceptable, and project planning documents should be submitted to NJDEP and EPA by 5/3/2019.

QAPP WORKSHEET #10: CONCEPTUAL SITE MODEL

See Section 2 of Groundwater Investigation Work Plan.

QAPP WORKSHEET #11: PROJECT/DATA QUALITY OBJECTIVES

See Section 3 of Groundwater Investigation Workplan.

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group or Method: Alkalinity by SM 2320B-2011 or EPA 310.1; WI11475
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias	Laboratory statistical window	Laboratory Control Spike/Matrix Spike, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > LOQ or >1/10 the amount measured in any sample	Method Blank	A
Precision	Laboratory statistical RPD	Lab Duplicate	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP – Groundwater Investigation Work Plan
LOQ - limit of quantification
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group or Method: Sulfide by SM 4500 S2D-2011 or EPA 376.2; WI11483
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias/Precision	Laboratory statistical or method window and RPD, whichever is tighter	Laboratory Control Spike/Matrix Spike and their Duplicates, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample	Method Blank	A
Precision	Laboratory statistical RPD	Lab Duplicate	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP – Groundwater Investigation Work Plan
LOQ - limit of quantification
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group or Method: Wet Chemistry – Inorganic Ions by IC (NO3, SO4) by EPA 300.0/9056; WI11626 Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias	Method limits	Laboratory Control Spike/Matrix Spike, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected <MDL or >1/10 the amount measure in any sample.	Method Blanks	A
Precision	Laboratory statistical	Lab Duplicate	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
MDL - method detection limit
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group or Method: Orthophosphate as Phosphorous by EPA 365.3; WI11511
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias	Laboratory statistical windows	Laboratory Control Spike/Matrix Spike, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > LOQ or >1/10 the amount measured in any sample	Method Blank	A
Precision	Laboratory statistical RPD	Lab Duplicate	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
LOQ - limit of quantification
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group or Method: Total Organic Carbon by SM 5310C/EPA 415.1; WI11637
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias	Laboratory statistical limits	Laboratory Control Spike/Matrix Spike, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > MDL or >1/10 the amount measured in any sample	Method Blank	A
Precision	Laboratory statistical RPD	Lab Duplicate	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
MDL - method detection limit
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group by Method/SOP: Dissolved Hydrocarbons (Methane, Ethane, Ethene) by RSK175 or SW-846 8015C or D/WI9796
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy	Laboratory statistical windows	Surrogate Spike	A
Accuracy/Bias/Precision	Laboratory statistical limits	Laboratory Control Spike/Matrix Spike and their Duplicates, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > RL or >1/10 the amount measured in any sample	Method Blank	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Accuracy/Transport Contamination	No detected target compounds	Trip Blank	A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
RL – reporting limit
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group by Method/SOP: Wet Chemistry – Total Dissolved Solids (TDS) by SM 2540 C-2011; WI11597
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy	Laboratory statistical windows	Surrogate Spike	A
Accuracy/Bias/Precision	Laboratory statistical limits	Laboratory Control Spike/Matrix Spike and their Duplicates, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > RL or >1/10 the amount measured in any sample	Method Blank	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Accuracy/Transport Contamination	No detected target compounds	Trip Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
RL – reporting limit
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group by Method/SOP: Metals (Total and Dissolved Iron)- ICP/MS by EPA 200.8 WI11933
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias/Precision	Laboratory Statistical Limits; RPD ≤20%	Laboratory Control Spike/Laboratory Control Spike Duplicate, Method Detection Limit Study	A
Accuracy/Bias/Precision	Laboratory Statistical Limits; RPD ≤20%	Matrix Spike/Matrix Spike Duplicate	A
Accuracy/Laboratory Contamination	No analytes detected > 1/2 LOQ or 2.2x MDL, whichever is greater, or >1/10 the amount measured in any sample.	Method Blank	A
Precision	RPD ≤20%	Lab Duplicate	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
LOQ - limit of quantification
MDL - method detection limit
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group by Method/SOP: Perchlorate by SW-846 6850 WI9989
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias/Precision	Laboratory statistical limits	Laboratory Control Spike/Matrix Spike and their Duplicates, Method Detection Limit Study	A
Accuracy/Laboratory Contamination	No analytes detected > RL or >1/10 the amount measured in any sample	Method Blank	A
Precision	RPD <30%	Field Duplicate	S & A
Accuracy/Bias	No detected target compounds	Field Blank	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	Detection limits ≤ to Project Action Limits (See Worksheet #15)	Detection limits	A

Acronym list
GIWP - Groundwater Investigation Work Plan
RL – reporting limit
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA (CONTINUED)

Laboratory: Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Matrix: Groundwater
Analytical Group by Method/SOP: CSIA Perchlorate analysis
Concentration Level: Low

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Accuracy/Bias/Precision	Laboratory statistical limits	Normalization using $KClO_4$ isotopic reference materials	A
Accuracy/Bias/Precision	Laboratory statistical limits	Continuing Calibration Verification	A
Accuracy/ Bias	Laboratory statistical limits	Comparison of $KClO_4$ isotopic reference materials (USGS37, USGS38, USGS38) to certified specifications	A
Precision	RPD <30%	Field Duplicate	S
Accuracy/Bias	N/A	The sampling protocol is designed to concentrate the $KClO_4$ sample mass to overwhelm any noise associated with field contamination[1].	S & A
Representativeness/Completeness	Samples collected and analyzed as described in the GIWP and this QAPP Data Completeness > 90%	Data Completeness Check	S & A
Sensitivity	N/A	Sample result is reported as a ratio rather than an absolute value therefore there is no detection limit.	A

1. Field blanks are only recommended for CSIA analysis if the groundwater concentrations are in the mg/L range. Otherwise, the unique method of sample collection onto columns rather than collection of purge water in sample bottles is considered sufficient to avoid field blank interference. We do not anticipate any results in the mg/L range, and therefore no field blanks are planned.

Acronym list
GIWP - Groundwater Investigation Work Plan
RPD - relative percent difference
QAPP – Quality Assurance Project Plan

QAPP WORKSHEET #14: SUMMARY OF PROJECT TASKS

Sampling Tasks:

Perchlorate was last investigated in 2010, at which time the groundwater concentrations exceeded the Groundwater Quality Standard (GWQS) of 5 ug/L (EPA reference). The overall objective of this investigation is to determine the extent of the perchlorate plume:

- Collect Perchlorate groundwater samples to delineate the current extent of the perchlorate plume;
- Collect geochemical samples to characterize the geochemical properties of the subsurface;
- Collect water level measurements on site to assess groundwater flow;
- Collect field parameters, specifically temperature, pH, specific conductivity, dissolved oxygen (DO), turbidity, and oxidation reduction potential (ORP),
- Collect Compound-Specific Isotope Analysis (CSIA) samples to evaluate the presence and source of background perchlorate; and
- Collect Gene-trac samples to assess the potential for biological degradation of perchlorate in the subsurface.

See Section 4 of the Workplan (Geosyntec, 2019) for an overview of the conceptual basis and rationale for characterization for each task, followed by a discussion of the investigative methods.

Analytical Tasks:

- Groundwater elevation measurements
- Field geochemistry: pH, DO, ORP, specific conductance, turbidity and temperature by flow through water quality meter
- Groundwater analytical tasks to be analyzed by Eurofins Lancaster Laboratories Environmental will include:
  - Perchlorate via SW-846 6850
  - Metals (Total & Dissolved Iron) via USEPA Method 200.8
  - Dissolved Hydrocarbons (Methane, Ethane, Ethene) via RSK175 or SW-846 8015C
  - Total Dissolved Solids by SM 2540 C-2011
  - Total Organic Carbon via SM 5310C/ EPA 415.1
  - Orthophosphate as Phosphorous via EPA 365.3
  - Inorganic Ions by IC (NO_3 and SO_4) by EPA 300.0/9056
  - Sulfide by SM4500 S2D/ EPA 376.2
  - Alkalinity by SM 2320B-2011 or EPA 310.1
- Groundwater analytical tasks to be analyzed by Environmental Isotope Geochemistry Laboratory: University of Delaware will include Compound Specific Isotope Analysis
- Groundwater analytical tasks to be analyzed by SiREM will include Gene-Trac®

QAPP WORKSHEET #14: SUMMARY OF PROJECT TASKS (CONTINUED)

Quality Control (QC) Tasks:

For all samples collected for analysis by Eurofins Lancaster Laboratories Environmental, equipment blanks and field blanks will be collected to determine if contamination of samples has occurred in the field and, if possible, to quantify the extent of the impact on field samples. Trip blanks will be submitted along with all dissolved hydrocarbon samples at a frequency of one per cooler containing dissolved hydrocarbon samples. Field duplicate samples and matrix spike/matrix spike duplicate (MS/MSD) samples will also be collected (see Worksheet #20 for QC Sample frequency). The field duplicate QC samples will be submitted as blind duplicates with only the date collected recorded on the chain of custody (COC). The samples will be identified as duplicate, trip blank, equipment blank, and MS/MSD samples in the final report.

For all samples collected for analysis by University of Delaware, equipment, trip, and field blanks are not feasible given the method of sampling and would not provide a meaningful assessment of contamination since the sample result is provided as an isotopic ratio, rather than an absolute value. Additionally, the analysis method does not allow for MS/MSD analysis, therefore they will not be collected. The sample collection method is designed to collect a sufficient mass of perchlorate within the sample column by purging a large volume of sample water through the column so as to reduce the potential for interference from contamination. Field duplicate samples will be collected and submitted to the lab as blind duplicates with only the collection date recorded on the COC.

For all samples collected for analysis by SiREM no QC samples will be collected. The results from the Gene-Trac® analyses will not be used for any quantitative decisions on site; however, the standard control sample QCresults will be included with the reported results. The data will be used to inform decisions about the feasibility of various perchlorate remedies on site based on the presence or absence of certain biological populations which can degrade perchlorate.

A summary of the field QC samples to be collected during the sampling program are presented as follows:

- Trip blanks (for dissolved hydrocarbons only);
- Equipment blanks consisting of laboratory-supplied analyte-free water poured over or pumped through groundwater sampling equipment; Field blanks consisting of laboratory-supplied analyte free water poured into sample containers in the field for all analyses except for CSIA and Gene-Trac®;
- Field duplicate samples for all groundwater samples except for Gene-Trac®; and
- MS/MSD samples for all groundwater samples except for CSIA and Gene-Trac®.

QAPP WORKSHEET #14: SUMMARY OF PROJECT TASKS (CONTINUED)

Data Management

Data are generated from three primary pathways: i) data derived from field activities; ii) laboratory analytical data; and iii) validated data. Data from all three pathways are entered into the project database in an electronic format in accordance with the project protocols.

Data generated during field activities are recorded using a field log book and field forms. Forms will be reviewed for completeness and accuracy by the Field Manager. Pertinent data from the field forms are entered into the project database. Hard copy field records are stored in a secure project file.

Data generated during laboratory analysis are recorded in hard copies, electronic reports in pdf format, and in electronic data deliverables (EDDs) after the samples have been analyzed. These data are then submitted for data validation. Data validation is performed in accordance with Worksheets #33, #34, #35, #36, and #37. The data validation team works with the project database manager to facilitate the uploading of the validated data into the project database in accordance with the project protocols.

Hard copies of field forms, data, and chain of custody (COC) forms are filed in a secure storage area. Laboratory data packages and reports are archived at the Geosyntec project office for a minimum of 15 years. Laboratories that generated the data archive data for 5 years unless instructed not to per project specifications. Field data are recorded manually in the project field book and uploaded to the project drive on a daily basis (i.e., scanned copies of hand-written notes).

Documentation and Records

In association with sample collection, field personnel are required to document all pertinent data, including date, time, location (coordinates), field personnel, weather conditions, instrument identification, and any other factors that may affect data quality. COC procedures in Worksheet #27 are followed for all samples. Hardcopy data (e.g., field note books; photos; hard copies of COC forms; and other items) are housed at Geosyntec offices and kept in the project files.

Assessment/Audit Tasks

Review of standard operating procedures (SOPs) relating to field, data validation, and project activities is required prior to project start. Audit records of the laboratories are maintained by the laboratory and available upon request.

QAPP WORKSHEET #15: PROJECT ACTION LIMITS AND LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS

Laboratory: Eurofins Lancaster Laboratory Environmental, Lancaster, PA
Matrix: Groundwater

Analyte	CAS Number	Project Action Limit (mg/L)	Project Quantitation Limit Goal[1] (mg/L)	Method Specific		Laboratory Specific	
				Method Detection Limit (mg/L)	Quantitation Limit (mg/L)	Method Detection Limit (mg/L)	Quantitation (Reporting) Limit (mg/L)
Perchlorate	PHCDC10C28	0.005	0.001	0.0002	0.001	0.0002	0.001
Nitrate	14797-55-8	--	0.5	0.25	0.5	0.25	0.5
Sulfate	14808-79-8	--	4.5	1.5	4.5	1.5	4.5
Orthophosphate as Phosphorous	7723-14-0	--	0.01	0.003	0.01	0.003	0.01
Total Alkalinity	--	--	5	1.7	5	1.7	5
TOC	--	--	1	0.5	1	0.5	1
TDS	--	--	20	20	60	20	60
Sulfide	18496-25-8	--	0.1	0.1	0.2	0.1	0.3
Iron (Total and Dissolved)	7439-89-6	--	0.0228	0.0228	0.1	0.0228	0.1
Methane	74-28-8	--	0.003	0.003	0.005	0.003	0.005
Ethane	74-84-0	--	0.001	0.001	0.005	0.001	0.005
Ethene	74-85-1	--	0.001	0.001	0.005	0.001	0.005

1. For each compound, the project quantitation limit goal is equal to the laboratory's quantitation limit or Reporting Limit (RL).
- = not applicable

Acronym list
mg/L – milligrams per Liter
TDS-Total Dissolved Solids
TOC- Total Organic Carbon

QAPP WORKSHEET #15: PROJECT ACTION LIMITS AND LABORATORY-SPECIFIC DETECTION/QUANTITATION LIMITS (CONTINUED)

Laboratory: Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Matrix: Groundwater

Analyte	CAS Number	Project Action Limit	Project Quantitation Limit Goal	Method Specific		Laboratory Specific	
				Method Detection Limit	Quantitation Limit	Method Detection Limit	Quantitation (Reporting) Limit
Perchlorate	PHCDC10C28	NA[1]	NA	NA	NA	NA	NA

1. Compound Specific Isotopic Analysis sample results are reported as ratios rather than absolute values therefore there is no detection limit or project action limit. Data analysis will be dependent upon the sample results' variation from known endmember perchlorate ratios. A mixing model will be used to determine the influence of various endmembers on the samples collected and statistical significance will be used as an indicator of data usability.

QAPP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

See Section 4 of Groundwater Investigation Workplan.

QAPP WORKSHEET #18: SAMPLING LOCATIONS AND METHODS

See Table 1 of the Groundwater Investigation Work Plan.

QAPP WORKSHEET #19: ANALYTICAL SOP REQUIREMENTS TABLE

Laboratory: Eurofins Lancaster Laboratory Environmental, Lancaster, PA
Matrix: Groundwater

Matrix	Analytical Group	Analytical and Preparation Method	Laboratory SOP	Sample Volume/Mass per Analysis	Containers (number, size, and type)	Preservation Requirements (Chemical, temperature, light protected)	Max Holding Time
Groundwater	Alkalinity	SM 2320B-2011 or EPA 310.1	WI11475	250 mL	250 mL plastic or glass bottle	Cool, ≤6°C	14 days
	Sulfide (colorimetric)	SM4500 S2D/ EPA 376.2	WI11483	250 mL	250 mL glass bottle	Cool, ≤6°C, no headspace, NaOH, ZnAc	7 days
	Anions: Nitrate and Sulfate	EPA 300.0 or SW-846 9056	WI11626	50 mL	50 mL plastic vial	Cool, ≤6°C	28 days
	Orthophosphate as Phosphorous	EPA 365.3	WI11511	250 mL	250 mL plastic or glass bottle	Cool, ≤6°C, Filter 0.45 µ on-site	48 hours
	Total Organic Carbon	SM 5310C/EPA 415.1	WI11637	40 mL	2 x 40 mL amber glass vial	Cool, ≤6°C, H3PO4 to pH <2	28 days
	Total Dissolved Solids	SM 2540 C-2011	WI11597	250 mL	500 mL plastic or glass bottle	Cool, ≤6°C	7 days
	Methane, Ethane, Ethene	RSK175/ or SW-846 8015C or D	WI9015178	40 mL	2 x 40 mL glass vials, no headspace	HCL to pH<2; Cool, ≤6°C, no headspace	7 days
	Metals (Total and Dissolved Iron)	EPA 200.8	WI11933	250 mL	250 mL plastic	Field filter 0.45 µ (dissolved); HNO3 to pH <2 (total and dissolved)	6 months
	Perchlorate	SW-846 6850	WI9989	40 mL	40 mL glass vial	Cool, ≤6°C	28 days

Acronym list
mL – milliliters
SOP – Standard Operating Procedure

QAPP WORKSHEET #19: ANALYTICAL SOP REQUIREMENTS TABLE (CONTINUED)

Laboratory: Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Matrix: Groundwater

Matrix	Analytical Group	Analytical and Preparation Method	SOP	Sample Volume/Mass per Analysis (mg)[2]	Containers (number, size, and type)	Preservation Requirements (Chemical, temperature, light protected	Max Holding Time
Groundwater	CSIA	CSIA	ESTCP: Guidance Manual for Forensic Analysis of Perchlorate in Groundwater using Chlorine and Oxygen Isotopic Analyses[1]	10	1 ion exchange column (1.25" by 3")	Filtered, none, 2-4° C	NA

1. There is no SOP for CSIA sampling, protocols will be based on the provided guidance document with any updates required.
2. Volume of sample water purged will vary by well, sample mass is listed as mg of total perchlorate. The sample mass will be collected by pumping the required volume of water (i.e., 2000 L for a well with a perchlorate concentration of 5 µg/L) through the ion exchange column at a rate of no greater than 2L/min to adsorb all perchlorate to the resin within the ion exchange column.

Acronym list
CSIA – Compound-Specific Isotope Analysis
ESTCP - Environmental Security Technology Certification Program
SOP – Standard Operating Procedure
mg - milligram

QAPP WORKSHEET #20: FIELD QC SUMMARY

Laboratory: Eurofins Lancaster Laboratory Environmental, Lancaster, PA
Matrix: Groundwater

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference	No. of Field Duplicate Pairs	No. of MS/MSD	No. of Field Blanks	No. of Equipment Blanks	No. of Trip Blanks
Groundwater	Alkalinity	Low	SM 2320B-2011 or EPA 310.1	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A
	Sulfide (colorimetric)	Low	SM4500 S2D/ EPA 376.2	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A
	Anions: Nitrate and Sulfate	Low	EPA 300.0 or SW-846 9056	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A
	Orthophosphate as Phosphorous	Low	EPA 365.3	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A
	Total Organic Carbon	Low	SM 5310C/EPA 415.1	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A
	Total Dissolved Solids	Low	SM 2540 C-2011	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A

Acronym list
MS/MSD - Matrix Spike/Matrix Spike Duplicate

QAPP WORKSHEET #20: FIELD QC SUMMARY (CONTINUED)

Laboratory: Eurofins Lancaster Laboratory Environmental, Lancaster, PA
Matrix: Groundwater

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference	No. of Field Duplicate Pairs	No. of MS/MSD	No. of Field Blanks	No. of Equipment Blanks	No. of Trip Blanks
Groundwater	Dissolved Hydrocarbons (Methane, Ethane, and Ethene)	Low	RSK175/ or SW-846 8015C or D	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	1 per cooler
	Metals (Total and Dissolved Iron)	Low	EPA 200.8	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A
	Perchlorate	Low	SW-846 6850	1 per 20 samples	1 per 20 samples	1 per day or 1 per 20 samples whichever is greater	1 per day or 1 per 20 samples whichever is greater	N/A

Acronym list
MS/MSD - Matrix Spike/Matrix Spike Duplicate

QAPP WORKSHEET #20: FIELD QC SUMMARY (CONTINUED)

Laboratory: Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Matrix: Groundwater

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference	No. of Field Duplicate Pairs	No. of MS/MSD	No. of Field Blanks	No. of Equipment Blanks	No. of Trip Blanks
Groundwater	CSIA	Low	ESTCP: Guidance Manual for Forensic Analysis of Perchlorate in Groundwater using Chlorine and Oxygen Isotopic Analyses[1]	1 per 10 samples	N/A	N/A	N/A	N/A

1. There is no SOP for CSIA sampling, protocols will be based on the provided guidance document with any updates required.

Acronym list
CSIA – Compound-Specific Isotope Analysis
ESTCP - Environmental Security Technology Certification Program
MS/MSD - Matrix Spike/Matrix Spike Duplicate
SOP – Standard Operating Procedure

QAPP WORKSHEET #21: FIELD SOPS

SOP Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP 100	Water Level Measurement Procedures, February 2007	Geosyntec Consultants	Not applicable	N	-
SOP 101	Field Documentation, Sample Designation, Custody and Handling Procedures, November 2014	Geosyntec Consultants	Not applicable	N	-
SOP 104	Management and Disposal of Investigation Derived Waste, November 2014	Geosyntec Consultants	Applies to purge water, section 2	N	-
SOP 106	Water and NAPL Level Measurement Procedures, November 2014	Geosyntec Consultants	Not applicable	N	-
SOP 108	Collection of Groundwater Samples, November 2014	Geosyntec Consultants	Samples will be collected by pump	N	-
SOG NJ1	Dissolved Oxygen (DO) Calibration, Revision 1, April 2018	Geosyntec Consultants	Not applicable	N	-
SOG NJ2	Specific Conductance Calibration, Revision 1, April 2018	Geosyntec Consultants	Not applicable	N	-
SOG NJ3	Temperature Calibration, Revision 1, April 2018	Geosyntec Consultants	Not applicable	N	-
SOG NJ4	Turbidity Calibration, revision 1, April 2018	Geosyntec Consultants	Not applicable	N	-
SOG NJ5	pH Calibration, revision 1, April 2018	Geosyntec Consultants	Not applicable	N	-

Acronym list
SOP – Standard Operating Procedure
SOG – Standard Operating Guideline

QAPP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

YSI 650MDS with YSI 600 XL/XLM, 6920, or 6820 sonde; YSI 556; or equivalent

Parameters: YSIs will be utilized during groundwater sampling and monitoring to analyze for dissolved oxygen, specific conductivity, temperature, pH, and oxidation/reduction potential.

Calibration: Parameter-specific calibration solutions will be used to calibrate individual sensors. Calibration parameters will include:

- Conductivity: Single-point calibration
- Turbidity: Three-point calibration
- Dissolved oxygen: Single-point calibration (100% saturation in air)
- Temperature: Factory calibrated (temperatures of all calibration standards should be recorded during calibration)
- pH: Three-point calibration (including 7.0)
- Oxidation/Reduction potential (ORP): Single-point calibration

Calibration will be performed in accordance with instrument instruction manuals. Ensure that calibration solutions are not past the expiration date prior to calibration. Expired solutions will not be used to calibrate instruments. Water depth does not require calibration.

Maintenance: see below SOPs.

Inspection: The YSI Sonde should be inspected throughout the day during real-time use to ensure proper function. Sensors should be inspected for cleanliness and integrity. Cables should be inspected for cuts and abrasions and display units should be inspected for proper function. All inspection activities should be documented, as appropriate.

Frequency: Calibration should be done at the beginning of the day, and whenever readings are outside of acceptable limits (see below). Inspection should be done during testing, calibration or whenever damage to the YSI may have occurred. A final calibration check will be recorded at the end of the day.

Acceptance:

Parameter	Units	Criteria
pH	pH units	± 0.3 pH units
ORP	mV	± 10 mV
Temperature	°C	NA
Conductivity	µS/cm	± 5% of standard or ± 10 µS/cm (whichever is greater)
Dissolved Oxygen	mg/L	± 0.5 mg/L of sat. value

Acronym list

SOP – Standard Operating Procedure

QAPP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION (CONTINUED)

YSI 650MDS with YSI 600 XL/XLM, 6920, or 6820 sonde; YSI 556; or equivalent (continued)
Corrective Action: The initial corrective action for parameters falling outside of the acceptable accuracy range will be inspection of deficient sensors for dirt, deposits, or damage followed by recalibration of affected sensors. YSI recalibration should be conducted whenever readings fall outside of acceptance criteria. Some minor repairs or replacements, such as replacement of dissolved oxygen sensor membranes, may be done by field team members on site, while other repairs will require a professional repair service. Replacement batteries should be kept on hand for prompt replacement if battery levels are observed to be low or error codes indicate low batteries. Separate batteries are required for the YSI Sonde and digital display, and both should be kept on hand. If midday or end-of-day checks identify results outside acceptance criteria, readings taken during the portion of the day when results may have been inaccurate should be noted and qualified.
Responsible Person: Field Team Leader
SOP Reference: SOG NJ1, SOG NJ2, SOG NJ3, SOG NJ5

Turbidity Meter
Parameters: The groundwater sampling and monitoring will utilize turbidity meters to analyze for turbidity.
Calibration: Calibration will be performed using a three-point calibration curve in accordance with instrument instruction manuals and SOG NJ4. Ensure that calibration solutions are not past the expiration date prior to calibration. Expired solutions will not be used to calibrate instruments.
Maintenance: see SOG NJ4
Inspection: Equipment shall be inspected for defects upon receipt, prior to calibration, and periodically during sampling.
Frequency: Calibration is performed at the beginning of the day. Calibration checks will be done after initial calibration and at the end of the day. Testing and inspection should be done if there are any incidents which may cause damage to the unit.
Acceptance: see SOG NJ4
Corrective Action: If there is any indication that the equipment is broken or malfunctioning, it will be replaced or returned to the rental company for replacement.

Acronym list

SOG – Standard Operating Guideline

QAPP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION (CONTINUED)

MINI RAE 2000 and 3000
Parameters: The mini RAE 2000 is a photoionization detector (PID) that generally measures VOCs such as isobutylene, hexane, xylene, benzene, styrene, toluene, and vinyl chloride, but can be calibrated to identify other volatile gases. The instrument will be used to evaluate work areas for health and safety and PPE requirements.
Calibration: Calibration should be performed at the beginning of each work day. The calibration will be a two-point curve including a "fresh air" calibration at 0.0 ppm and a span gas calibration at 100 ppm. Calibration procedures are outlined in the MiniRAE instruction manual. A correction factor may need to be used for certain gases (see MiniRAE user manual for more information). Lower and upper alarm limits should match criteria outlined in the Health and Safety Plan for PPE upgrade conditions (generally 5 ppm and 50 ppm, sustained). Calibration should be documented daily. Ensure that calibration span gas has not expired. Expired calibration gases should not be used to calibrate the PID.
Maintenance: Battery should be charged daily and will require replacing in the field when it can no longer recharge. PIDs are sensitive to moisture; therefore, a moisture/particulate filter should always be used, fitted on the PID intake. If the lamp or lamp housing becomes wet or soiled, these areas will require cleaning in accordance with the MiniRAE user manual. Additionally, filters will require replacement after use. Indications that a filter, particulate or vapor, requires replacement include: visible particulate matter, inability for unit to zero, tearing, or obstruction of flow (audible indication of pump straining). The PID digital display should be kept from overexposure to water and sunlight to maximize display longevity. Common replacement parts that will be immediately available during PID use are listed below: • Vapor filters; • Particulate filters; • AA batteries; and • Replacement lamps. All maintenance and corrective action activities should be appropriately documented on field forms and/or in field logbooks.

QAPP WORKSHEET #23: ANALYTICAL SOPS

Reference Number	Title	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI11475	*Multi-Parameters in Solids and Waters by Man-Tech Multi-Parameter System Rev 11; effective 3/21/19*	Definitive	Water	Man-Tech Multi-Parameter System	Eurofins Lancaster Laboratories Environmental	N
WI11483	*Colorimetric Sulfide in Waters (#0230), Sulfide as H2S (#10293 Calculation), Dissolved Sulfide in Water (#10499) by 4500-S2 B/C/D-2011, 4500-S2 F-2011, or EPA 376.2, Rev 17, effective 3/15/18*	Definitive	Water	UV Spec	Eurofins Lancaster Laboratories Environmental	N
QA-SOP11880	*Balance, Syringe, Pipette, and Labware Verification, Rev 9, effective 07/02/18*	Definitive	Maintenance	Balance	Eurofins Lancaster Laboratories Environmental	N
WI11519	*pH Probes and Meters, Rev 13, effective 10/13/16*	Definitive	Water and Solid	pH Meter	Eurofins Lancaster Laboratories Environmental	N
WI11626	*Determination of Inorganic anions by Ion Chromatography in Waters and Soil by EPA 300.0, SW 846 9056, and SW 846 9056A, Rev 22, effective 12/24/18*	Definitive	Water and Solid	IC	Eurofins Lancaster Laboratories Environmental	N
WI11511	*Orthophosphate (Colorimetric) by EPA 365.3 in Waters, Rev 12, effective 5/09/18*	Definitive	Water	UV Spectrophotometer	Eurofins Lancaster Laboratories Environmental	N

QAPP WORKSHEET #23: ANALYTICAL SOPS (CONTINUED)

Reference Number	Title	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI11637	*Determination of Total Organic Carbon, Dissolved Organic Carbon, and Inorganic Carbon in Water and Wastewater, Rev 16, effective 9/25/18*	Definitive	Water	TOC Analyzer	Eurofins Lancaster Laboratories Environmental	N
WI11598	*Total Dissolved Solids (TDS)(Gravimetric) by 2540C-2011 or EPA 160.1 in Waters and Wastewaters, Rev 16, effective 4/08/19*	Definitive	Water	NA	Eurofins Lancaster Laboratories Environmental	N
WI9796	*Volatile Hydrocarbons in Water by Method RSK-175 Modified and SW-846 8015 Using Headspace Sampling Techniques and GC-FID, Rev 18, effective 12/05/18*	Definitive	Dissolved Hydrocarbons	GC	Eurofins Lancaster Laboratories Environmental	N
WI9689	*Maintenance and Troubleshooting Procedures for GC/FID Instrumentation, Rev 8, effective 1/16/2015*	N/A	Maintenance	N/A	Eurofins Lancaster Laboratories Environmental	N
WI11933	*Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A/6020B (aqueous, solid, tissue), and EPA 200.8 (aqueous), Rev 8, effective 09/25/18*	Definitive	Solid, liquid, tissues Metals	ICP/MS	Eurofins Lancaster Laboratories Environmental	N
WI9989	*Perchlorate by Method 6850 in Waters and Solids by LC/MS/MS, Rev 13, effective 03/22/19*	Definitive	Perchlorate by LC/MS/MS	LC/MS/MS	Eurofins Lancaster Laboratories Environmental	N

QAPP WORKSHEET #23: ANALYTICAL SOPS (CONTINUED)

Reference Number	Title	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
WI10008	*Preventive and corrective HPLC Maintenance for the Pesticide Residue Analysis Department, Rev 6, effective 5/17/13*	NA	Maintenance	NA	Eurofins Lancaster Laboratories Environmental	N
ESTCP Project ER-200509	*Guidance Manual for Forensic Analysis of Perchlorate in Groundwater using Chlorine and Oxygen Isotopic Analyses*[1]	Definitive	Waters	IRMS	Environmental Isotope Geochemistry Laboratory: University of Delaware	TBD

1. There is no SOP for CSIA sampling, protocols will be based on the provided guidance document with any updates required.
2. Potential modifications will be decided based on first round of sampling.

Acronym list

GC – gas chromatography
IC – ion chromatography
IRMS – isotope-ratio mass spectrometry
LC – liquid chromatograph
MS – mass spectrometer
TOC – total organic carbon

QAPP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA

Parameter	Calibration Procedure/Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
pH electrode: Alkalinity	Calibration using at least 3 points, sloped with pH 4, 7, and 10 buffers	Daily	percent slope between 92% and 102%	Correct the problem and recalibrate	ELLE Analyst	WI11475
	CCV Standard	After each calibration, every 10 samples, and end of batch	±10% D	Correct the problem, recalibrate and reanalyze affected samples		
Sulfide	Calibration using at least 5 points ranging from 0.10 to 2.0 mg/l	Every 3 months or when a new reagent is prepared	Correlation coefficient must be ≥0.995	Correct the problem and recalibrate	ELLE Analyst	WI11483
	CCV Standard	Beginning of each batch, every 10 samples, and end of batch	±10% D	Correct the problem, recalibrate and reanalyze affected samples		
IC Anions 300.0 or SW-846 9056	Initial calibration with a minimum of 5 points with a concentration span of 15x or 30x depending on the analyte	Every 60 days or when CCV fails	r >0.995; Level 1 standard must recover ≥50% of the true value	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI11626
	ICB	After each initial calibration	No analytes detected > MDL	Correct problem and reanalyze the ICB. Recalibrate if needed.		
	ICV	After each initial calibration	Within +/- 10% of the nominal concentration	If ICV fails again do system maintenance and recalibrate.		
	CCV	Every 10 injections	Within +/- 10% of the nominal concentration	Recalibrate; reanalyze affected samples		
	CCB	Every 10 injections	No analytes detected > MDL	Recalibrate; reanalyze affected samples		

QAPP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA

Parameter	Calibration Procedure/Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
UV Spectrophotometer	Initial Calibration with a minimum 5 points ranging from 0.1 mg/L to 0.8 mg/L.	Quarterly	Correlation Coefficient of >0.995	Recalibrate, perform instrument maintenance if calibration cannot conform to criteria, recalibrate	ELLE Analyst	WI11511, WI11495, WI11537
	ICV Standard	After each ICAL	±10% D	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.		
	CCV Standard	Every 10 samples	±10% D	Reanalyze affected samples		
TOC Analyzer: TOC, DOC, & TIC in Water	Initial calibration with a minimum 6 points ranging from 1.0 ppm to 100 ppm	Monthly or after continuing calibration fails	$r^2 \geq 0.995$	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI11637, WI11682
	ICB Standard	After each initial calibration	No analytes detected > LOQ	Perform more aggressive instrument maintenance and recalibrate		
	ICV Standard	After each initial calibration	Within +/- 10% of the nominal concentration	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.		
	Total Inorganic Check Standard	Daily	Within +/- 20% of the nominal concentration	All affected samples are reanalyzed		
	CCV Standard	If instrument is idle > 4 hours, after every 10 field samples, and at the end of the sequence	Within +/- 10% of the nominal concentration	All affected samples are reanalyzed		
	CCB Standard	If instrument is idle > 4 hours, after every 10 field samples, and at the end of the sequence	No analytes detected > LOQ	All affected samples are reanalyzed		
Total Dissolved Solids	NA	NA	NA	NA	ELLE Analyst	WI11598

QAPP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA

Parameter	Calibration Procedure/Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Gas Chromatography Dissolved Hydrocarbons	Initial calibration with 6 points ranging from 2 ppb to 500 ppb depending on the compound	After continuing calibration fails	%RSD for ICAL ≤20%, linear $r^2 \geq 0.99$	Perform more aggressive instrument maintenance and recalibrate	ELLE Analyst	WI9796
	MDL Standard	After each initial calibration	All compounds must be detected	Repeat initial calibration procedure prior to analyzing samples. Repeat maintenance if needed.		
	ICV Standard	After each initial calibration	Target compounds +/- 15% of the nominal concentration and within established retention time windows	Reanalyze the ICV. If ICV fails again do system maintenance and recalibrate.		
	CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	For RSK-175: Target compounds +/- 15% of the nominal concentration. For SW-846 8015C/D: Target compounds +/- 20% of the nominal concentration.	All samples since acceptable CCV must be reanalyzed. If the CCV fails high, any associated samples that are ND can be reported.		

QAPP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA

Parameter	Calibration Procedure/Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP/MS: 200.8	Tuning	Daily	No AMU diff. of >0.1 P.W. ≥0.64 and ≥0.66 (Elan 9000) or P.W. <0.9 at 10% height (Agilent); %RSD <5 for masses used for tuning	Perform mass calibration for AMU. Adjust mass calibration for P.W.	ELLE Analyst	WI11933
	Initial Calibration consists of Blank and 1 point: 0 and 10,000 ppb for Al, Ca, Fe, Mg, K, Na; 0 and 1,000 ppb for As, Ba, Cr, Co, Cu, Mn, Ni, Ti, V, Zn; 0 and 100 ppb for Sb, Be, Cd, Pb. Mo, Se, Ag, Sr, Tl, Sn	Each new run	Passing ICV and ICB	Recalibrate, perform instrument maintenance if calibration cannot conform to criteria, recalibrate		
	ICV	After each calibration	±10% of true value	Reanalyze		
	ICB	Immediately after the ICV	Less than 3x IDL	Positive result: accept sample results >10X the ICB or < 1/2 RL. Negative result: accept results >10x ICB. All other samples must be reanalyzed with compliant ICB		
	CCV	Immediately after the ICSAB and every 10 samples	±10% of true value	If the CCV is out of specification and the result is not < - LOQ, accept results that report as non-detect for the affected analyte(s). Results for the affected analyte(s) ≥ to the reporting limit must not be reported (reanalyze).		

QAPP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA

Parameter	Calibration Procedure/Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP/MS: 200.8 (continued)	CCB	Immediately after the CCV and every 10 samples	Less than 3x IDL	Positive result: accept sample results >10X the ICB or < 1/2 RL. Negative result: accept results >10x ICB. All other samples must be reanalyzed with compliant CCB	ELLE Analyst	WI11933
	Interference Check Sample	At the beginning of each run immediately following the LLC	± 20% of the true value for each analyte	Recalibrate		
	Low Level Check (LLC)	Beginning of each sequence and before the interference check samples	± 50% of the true value. Not applicable if sample concentrations are >10x the true value of the LLC.	Reanalyze the sample		
	Linear Range	Quarterly	±10% of true value	Samples > 90% of the linear range must be reanalyzed as a dilution		
HPLC/MS/MS Perchlorate 6850	Tuning	Required prior to analysis and at end of sequence.	The mass axis tolerances for unit width are 0.10, for wide width they are 0.60, for the widest width they are 1.25.	Clean spray chamber. If needed, perform maintenance on the MS and then retune	ELLE Analyst	WI9989
	Initial calibration with a minimum 5 points. Ranges from a standard at or near the reporting limits through 20x the first level	After continuing calibration fails	correlation coefficient ≥0.995.	Perform more aggressive instrument maintenance and recalibrate		
	MDL Standard	After each initial calibration	Perchlorate must be detected	Repeat initial calibration procedure prior to analyzing samples. Repeat maintenance if needed.		

QAPP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA

Parameter	Calibration Procedure/Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC/MS/MS Perchlorate 6850 (continued)	ICV Standard	After each initial calibration	Within +/-15% of the nominal concentration and within established retention time windows	Reanalyze the ICV and samples associated with the non-compliant ICV. If ICV fails again do system maintenance, recalibrate, and reanalyze samples.	ELLE Analyst	WI9989
	CCV Standard	Prior to sample analysis, after every 10 field samples, and at the end of the sequence. Alternate between low- and mid-range concentrations	Within ±15% for mid-range and ±50% for low-range of the nominal concentration and within established retention time windows	All samples since acceptable CCV must be reanalyzed. If the CCV fails high, any associated samples that are ND can be reported.		
Isotope Ratio Mass Spectrometer	CCV Standard	Prior to sample analysis, after every 4 field samples, and at the end of the sequence.	Within analytical uncertainty (typically ±0.5‰)	Reanalyze the CCV and associated samples.	University of Delaware Analyst	N/A

Acronym list

AMU - Atomic Mass Unit
CCB - Continuing Calibration Blank
CCV - Continuing Calibration Verification
ICB - Initial Calibration Blank
ICP - Inductively Coupled Plasma
ICV - Initial Calibration Verification
IDL – Instrument Detection Limit
LLC – Low Level Check
LOQ – Limit of Quantitation
MDL – Method Detection Limit
mg/L – milligrams per Liter
MS – Mass Spectrometer
ND – None Detected
SOP – Standard Operating Procedure

QAPP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
pH/ISE Meter	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11519
Analytical balance	Assure the balance is in a vibration-free area, is level, and the interior housing is clean.	Verification with ASTM certified weights	Visual inspection and weight verification	Each day of use	The reading must be ±0.1% or ±0.5mg, whichever is greater.	1) verify cleanliness of weights 2) remove balance from service and place a call to service firm 3) management must evaluate data generated since last acceptable reading to determine any potential impacts to data quality	ELLE analyst	QA-SOP-11880
Analytical balance	Annual calibration and maintenance	Annual calibration and maintenance	Annual calibration and maintenance	Annual	As per vendor's specifications in compliance with ISO certification	As per vendor's specifications in compliance with ISO certification	Professional calibration vendor (ISO 17025 certified)	QA-SOP-11880
IC	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks (95-105% for method 218.6)	Recalibration	ELLE Analyst	WI11625

QAPP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION (CONTINUED)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Total Organic Carbon Analyzer	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/calibration checks every 10 injections	90-110% for calibration checks	Recalibration	ELLE Analyst	WI11637
HP5890, HP6890, or Agilent 7890 Gas Chromatograph with Flame Ionization Detector	Injection port maintenance; Column; FID maintenance	Continuing Calibration Check	Visual Inspection	As Needed	Initial Calibration within Specifications	Perform Maintenance again; re- calibrate if necessary	ELLE analyst	WI9689
Agilent 7500 CE	As needed replacement of components	Calibration checks	Visual inspection of components	As needed maintenance/ calibration checks every 10 injections	90-110% for the calibration checks	Recalibration	ELLE Analyst	WI11933
Agilent 1200 or HP 100 series LC/MS/MS or equivalent	Injection port maintenance; MS/MS detector maintenance	Calibration Check All analytes within +/- 15% of the nominal concentration and within established retention time windows	Visual Inspection	As needed	Initial calibration after maintenance is within specifications	Perform maintenance again	ELLE Analyst	WI10008

Acronym list

ASTM- American Society for Testing and Materials
FID - Flame Ionization Detector
IC – Ion Chromatography
MS – Mass Spectrometer
SOP – Standard Operating Procedures

QAPP WORKSHEET #26: SAMPLE HANDLING, CUSTODY, AND DISPOSAL

Sample Collection, Packaging, and Shipment
Sample Collection (Personnel/Organization): Field Manager, Geosyntec
Sample Packaging (Personnel/Organization): Field Manager, Geosyntec
Coordination of Shipment (Personnel/Organization): Field Manager, Geosyntec
Type of Shipment/Carrier: Courier or overnight shipping

Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): Sample Receiving Personnel, Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Sample Custody and Storage (Personnel/Organization): Sample Receiving Personnel, Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Sample Preparation (Personnel/Organization): Sample Receiving Personnel, Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Sample Determinative Analysis (Personnel/Organization): Sample Receiving Personnel, Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Sample Disposal
Personnel/Organization: Sample Receiving Personnel, Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Analysis: Field Samples are stored for 30 days after submittal of the completed data package.

QAPP WORKSHEET #26: SAMPLE HANDLING, CUSTODY, AND DISPOSAL (CONTINUED)

Sample Receipt and Analysis[1]
Sample Receipt (Personnel/Organization): Andrew Jackson, Civil and Environmental Engineering, Texas Tech University, 911 Boston, Box 41023, Lubbock, TX 79409-1023/ Sample Receiving Personnel, Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Sample Custody and Storage (Personnel/Organization): Andrew Jackson, Civil and Environmental Engineering, Texas Tech University, 911 Boston, Box 41023, Lubbock, TX 79409-1023/ Sample Receiving Personnel, Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Sample Preparation (Personnel/Organization): Andrew Jackson, Civil and Environmental Engineering, Texas Tech University, 911 Boston, Box 41023, Lubbock, TX 79409-1023/ Sample Receiving Personnel, Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Sample Determinative Analysis (Personnel/Organization): Andrew Jackson, Civil and Environmental Engineering, Texas Tech University, 911 Boston, Box 41023, Lubbock, TX 79409-1023/ Neil Sturchio, Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Sample Disposal
Personnel/Organization: Sample Receiving Personnel, Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE,
Analysis: Field Samples are stored for 30 days after submittal of the completed data package.

1. Extractions and Purification of CSIA samples occur at Texas Tech University Laboratory and Isotope Analyses are performed at the University of Delaware.

QAPP WORKSHEET #27: SAMPLE CUSTODY REQUIREMENTS

Chain-of-Custody Procedures:

Field sample personnel will use standard sample custody procedures to maintain and document sample integrity during collection, transportation, storage, and analysis. A sample will be considered to be in custody if one of the following statements applies:

- It is in a person's physical possession or view;
- It is in a secure area with restricted access; or
- It is placed in a container and secured with an official seal so that the sample cannot be reached without breaking the seal.

Chain of custody procedures provide an accurate written record that traces the possession of individual samples from the time of collection in the field to the time of acceptance at the laboratory. The chain of custody record will also be used to document the samples collected and the analyses requested. Information that the field personnel will record on the chain of custody record includes:

- Project name and number;
- Sampling location;
- Name of sampler;
- Destination of samples (laboratory name);
- Sample identification number;
- Date and time of collection;
- Number of containers filled;
- Analysis requested;
- Preservatives used (if applicable);
- Filtering (if applicable);
- Sample designation (grab or composite);
- Signatures of individuals involved in custody transfer, including the date and time of transfer; and
- Project contact and email address.

Field personnel will sign chain of custody records that are initiated in the field, and the air bill number will be recorded if applicable. The record will be placed in a waterproof plastic bag and taped to the inside of the shipping container used to transport the samples. Signed air bills will serve as evidence of custody transfer between field personnel and the courier, and between the courier and the laboratory. Copies of the chain of custody record and the air bill, if applicable, will be retained and filed by field personnel before the containers are shipped.

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

The following procedures will be implemented when samples collected during this project are shipped via laboratory courier or overnight shipping service:

- Confirm that sample labels are securely affixed to sample containers.
- Check the caps on the sample containers to confirm that they are properly sealed.

QAPP WORKSHEET #27: SAMPLE CUSTODY REQUIREMENTS (CONTINUED)

- Complete the COC form with the required sampling information and confirm that the recorded information matches the sample labels. The appropriate personnel will sign and date the COC form to document the sample custody transfer.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place cushioning material at the bottom of the cooler.
- Place the sealed sample containers and a temperature blank in the cooler.
- Place a sufficient amount of wet ice in the cooler to maintain a sample temperature of <6°C.
- Fill the remaining space in the cooler with cushioning material.

The following procedures will be implemented only when shipping via an overnight shipping service.

- Place the COC forms in plastic bags and seal. Tape the forms to the inside of the appropriate cooler lid.
- Close the cooler lid and secure with tape.
- Wrap tape around both ends of the cooler and attach custody seals to the cooler and cover with clear protective tape.
- Mark the cooler on the outside with the following information: Shipping address, return address, “Fragile” labels, and arrows indicating “This side up.” Place a signed custody seal over the cooler lid.

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):

Laboratory COC begins when samples are received and continues until samples are discarded. Sample custodians will receive the incoming samples, sign the accompanying COC forms, and retain copies of the COC forms as permanent records. The laboratory sample custodians will record the pertinent information concerning the samples, including the persons delivering the samples, the date and time received, sample condition at the time of receipt (sealed, unsealed, or broken container; temperature at laboratory receipt; or other relevant remarks), the sample identification numbers, and the unique laboratory identification numbers for the samples. This information should be entered into a computerized laboratory information management system (LIMS). The laboratory is responsible for maintaining records necessary to maintain custody throughout sample preparation and analysis.

The laboratory will provide a secure storage area for the samples. Access to this area will be restricted to authorized personnel. The custodian will confirm that samples requiring special handling, including samples that are heat- or light-sensitive, radioactive, or have other unusual physical characteristics, will be properly stored and maintained prior to analysis. Laboratory SOPs for sample custody, tracking, archiving and disposal are located at the laboratory and are available upon request.

QAPP WORKSHEET #27: SAMPLE CUSTODY REQUIREMENTS (CONTINUED)

Sample Identification Procedures:

A sample numbering system will be used to identify each sample collected for laboratory analysis. The numbering system will ensure that each sample is uniquely identified and will allow for retrieval of sample information about a particular sample location from a database. Parent samples and quality control samples will use the following formats for sample IDs:

Parent Sample	Well ID_YYYYMMDD	Ex: SC36D_20190731
Duplicate	DUP-XX	Ex: DUP-01
Matrix Spike	Well ID_ YYYYMMDD_MS	Ex: SC36D_20190731_MS
Matrix Spike Duplicate	Well ID_ YYYYMMDD_MSD	Ex: SC36D_20190731_MSD
Equipment Blank	EB_ YYYYMMDD	Ex: EB_20190731
Field Blank	FB_ YYYYMMDD	Ex: FB_20190731
Trip Blank	TB_ YYYYMMDD	Ex: TB_20190731

The sample identification given to duplicate samples will be consecutively numbered blind duplicate IDs, the project name, project number, preservative and date collected will be the only identifying information on the label, the time, well identification and sampler's initials sections of the label will all be left blank.

Duplicate sample example: duplicate for a groundwater sample collected from SC20S as the second duplicate of the sampling event on 25 September 2017 would be as follows: DUP-02.

Sample Labels

A sample label will be affixed to the sample containers, appropriate for the site and sample location. The label will be completed with the following information:

- Project name;
- Sample identification number;
- Date and time of sample collection;
- Preservative used (if applicable);
- Sample collector's initials.

Sample Documentation

Documentation during sampling is essential to confirm proper sample identification. Field personnel will adhere to the following general guidelines for maintaining field documentation:

- Documentation will be completed in permanent ink.
- All entries will be legible.
- Errors will be corrected by crossing out with a single line and then dating and initialing the lineout.
- Any serialized documents will be maintained in the project file and referenced in the site logbook.
- Unused portions of pages will be crossed out, and each page will be signed and dated.

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Alkalinity
Analytical Method/SOP: SM 2320B-1997 or EPA 310.1; WI11475

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blank	1 per prep batch of up to 20 samples	No analytes detected > LOQ or >1/10 the amount measured in any sample	Reanalyze blank to confirm detections. If detects confirm, reanalyze samples that are not ND or not >10x the blank value.	ELLE Analyst	See Worksheet #12
LCS	1 per prep batch of up to 20 samples	Laboratory statistical window	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-analyzed.	ELLE Analyst	See Worksheet #12
Duplicate	1 per 10 samples	Laboratory statistical RPD	Flag data	ELLE Analyst	See Worksheet #12

Acronym list

LCS – Laboratory Control Sample
LOQ – Limit of Quantification
MPC - Measurement Performance Criteria
MS – Matrix Spike
ND – None Detected
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Sulfide
Analytical Method/SOP: SM 4500 S2D/EPA 376.2; WI11483

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blank	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or >1/10 the amount measured in any sample	Reanalyze blank to confirm detections. If detects confirm, reanalyze samples that are not ND or not >10x the blank value.	ELLE Analyst	See Worksheet #12
MS	1 per 10 samples	Laboratory statistical or method window and RPD, whichever is tighter	Flag outliers	ELLE Analyst	See Worksheet #12
LCS	1 per prep batch of up to 20 samples	Laboratory statistical or method window and RPD, whichever is tighter	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-analyzed.	ELLE Analyst	See Worksheet #12
Duplicate	1 per 10 samples	Laboratory statistical RPD	Flag data	ELLE Analyst	See Worksheet #12

Acronym list

LCS – Laboratory Control Sample
LOQ – Limit of Quantification
MPC - Measurement Performance Criteria
MS – Matrix Spike
ND – None Detected
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Wet Chemistry – Inorganic Ions by IC (NO3 and SO4)
Analytical Method/SOP: EPA 300.0/9056; WI11626

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected <MDL or >1/10 the amount measure in any sample.	Reanalyze to confirm detections. If detects confirm re-extract samples that are not ND or not >10x the blank value	ELLE Analyst	See Worksheet #12
MS	1 per 10 samples	Method limits	Flag outliers	ELLE Analyst	See Worksheet #12
LCS	1 per prep batch of up to 20 samples	Method limits	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	See Worksheet #12
Duplicate	1 per 10 samples	Laboratory statistical	Flag outliers	ELLE Analyst	See Worksheet #12

Acronym list

LCS – Laboratory Control Sample
LOQ – Limit of Quantification
MPC - Measurement Performance Criteria
MS – Matrix Spike
ND – None Detected
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Orthophosphate as Phosphorous
Analytical Method/SOP: EPA 365.3; WI11511

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blank	1 per prep batch of up to 20 samples	No analytes detected > LOQ or >1/10 the amount measured in any sample	Reanalyze blank to confirm detections. If detects confirm, reanalyze samples that are not ND or not >10x the blank value.	ELLE Analyst	See Worksheet #12
Matrix Spike	1 per 20 samples	Laboratory statistical windows	Flag outliers	ELLE Analyst	See Worksheet #12
LCS	1 per prep batch of up to 20 samples	Laboratory statistical windows	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-analyzed.	ELLE Analyst	See Worksheet #12
Duplicate	1 per 20 samples	Laboratory statistical RPD	Flag data	ELLE Analyst	See Worksheet #12

Acronym list

LCS – Laboratory Control Sample
LOQ – Limit of Quantification
MPC - Measurement Performance Criteria
MS – Matrix Spike
ND – None Detected
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Total Organic Carbon
Analytical Method/SOP: SM 5310C/EPA 415.1; WI11637

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected 1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Reanalyze blank to confirm detections. If detects confirm, re-prep samples that are not ND or not >10x the blank value.	ELLE Analyst	See Worksheet #12
MS	1 per 10 samples	Laboratory statistical limits for compounds and RPD	Flag outliers	ELLE Analyst	See Worksheet #12
LCS	1 per prep batch of up to 20 samples	Laboratory statistical limits for compounds and RPD	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	See Worksheet #12
Duplicate	1 per 10 samples	Laboratory statistical RPD	Flag data	ELLE Analyst	See Worksheet #12

Acronym list

LCS – Laboratory Control Sample
LOQ – Limit of Quantitation
MPC - Measurement Performance Criteria
MS – Matrix Spike
ND – None Detected
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Total Dissolved Solids (TDS)
Analytical Method/SOP: SM 2540 C-2011; WI11597

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blank	1 per prep batch of up to 20 samples	No analytes detected > LOQ or >1/10 the amount measured in any sample	Reanalyze blank to confirm detections. If detects confirm, re-prep samples that are not ND or not >10x the blank value.	ELLE Analyst	See Worksheet #12
LCS	1 per prep batch of up to 20 samples	Laboratory statistical windows	Correct problem, re-prepare and reanalyze the LCS and all sample associated	ELLE Analyst	See Worksheet #12
Duplicate	1 per 10 samples	Method RPD	Flag data	ELLE Analyst	See Worksheet #12

Acronym list
LCS – Laboratory Control Sample
LOQ – Limit of Quantitation
MPC - Measurement Performance Criteria
ND – None Detected
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Dissolved Hydrocarbons (Methane, Ethane, Ethene)
Analytical Method/SOP: RSK175 or SW-846 8015C or D/WI9796

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Surrogate Spike	Per Sample (including Blanks, LCS/D, MS/D	Laboratory statistical limits	Reanalyze if outside limits, if confirmed, report	ELLE Analyst	See Worksheet #12
Method Blanks	1 per prep batch of up to 15 samples	No analytes detected > RL or >1/10 the amount measured in any sample	Reanalyze to confirm detections	ELLE Analyst	See Worksheet #12
MS/MSD	1 per prep batch of up to 15 samples	Laboratory statistical limits, RPD ≤30%	Flag outliers	ELLE Analyst	See Worksheet #12
LCS/D	1 per prep batch of up to 15 samples	Laboratory statistical limits, RPD ≤20%	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported.	ELLE Analyst	See Worksheet #12

Acronym list

LCS/D – Laboratory Control Sample/ Duplicate
MPC - Measurement Performance Criteria
MS/MSD - Matrix Spike/Matrix Spike Duplicate
ND – None Detected
RL – Reporting Limit
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Metals (Total and Dissolved Iron)
Analytical Method/SOP: EPA 200.8 WI11933

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method Blank	1 per prep batch of up to 20 samples	No analytes detected > 1/2 LOQ or 2.2x MDL, whichever is greater, or >1/10 the amount measured in any sample.	Reanalyze blank to confirm detections. If detects confirm, re-digest samples that are not ND or not >10x the blank value.	ELLE Analyst	See Worksheet #12
MS/MSD	1 per prep batch of up to 20 samples	Recovery limits 70 - 130%; RPD ≤20%	Analyze post digestion spike and serial dilution	ELLE Analyst	See Worksheet #12
LCS/LCSD	1 per prep batch of up to 20 samples	Recovery limits 85 - 115%; RPD ≤20%	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-digested and reanalyzed.	ELLE Analyst	See Worksheet #12
Duplicate	1 per prep batch of up to 20 samples	RPD must be ≤20%	Flag data	ELLE Analyst	See Worksheet #12
Serial Dilutions	Must be prepared with each background sample, evaluated only when analyte concentrations are >50x the MDL	The percent difference must be ≤10%	Flag data	ELLE Analyst	See Worksheet #12

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Metals (Total and Dissolved Iron) (continued)
Analytical Method/SOP: EPA 200.8 WI11933

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Post Digestion Spike (PDS)	Prepare with each background sample	± 15% True Value	No specific action needed unless required by the project. PDS is reported in data package	ELLE Analyst	See Worksheet #12

Acronym list

LCS/LCSD – Laboratory Control Sample / Laboratory Control Sample Duplicate
LOQ – Limit of Quantitation
MPC - Measurement Performance Criteria
MDL - Method Detection Limit
MS/MSD - Matrix Spike/Matrix Spike Duplicate
ND – None Detected
PDS - Post Digestion Spike
RPD – Relative Percent Difference
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Eurofins Lancaster Laboratories Environmental, Lancaster, PA
Matrix: Groundwater
Analytical Group: Perchlorates
Analytical Method/SOP: SW-846 6850/WI9989

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Method blanks	1 per prep batch of up to 20 samples	No analytes detected > RL or >1/10 the amount measured in any sample	Reanalyze to confirm detections. If detects confirm reextract samples that are not ND or not >10x the blank value	ELLE Analyst	See Worksheet #12
MS/MSD	1 per prep batch of up to 20 samples	Laboratory statistical limits	Flag outliers	ELLE Analyst	See Worksheet #12
LCS/LCSD	1 per prep batch of up to 20 samples	Laboratory statistical limits	Analytes in the LCS that fail high and are ND in the samples can be reported. All others are re-extracted.	ELLE Analyst	See Worksheet #12

Acronym list
LCS/LCSD – Laboratory Control Sample / Laboratory Control Sample Duplicate
MPC - Measurement Performance Criteria
MS/MSD - Matrix Spike/Matrix Spike Duplicate
ND – None Detected
RL – Reporting Limit
SOP – Standard Operating Procedures

QAPP WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION (CONTINUED)

Laboratory: Environmental Isotope Geochemistry Laboratory: University of Delaware, Newark, DE
Matrix: Groundwater
Analytical Group by Method/SOP: CSIA Perchlorate analysis[1]

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/position of person responsible for corrective action	Project-Specific MPC
Duplicate	1 per prep batch of up to 10 samples	Within analytical uncertainty (typically ±0.5‰)	Flag outliers	University of Delaware Analyst	See Worksheet #12

1. There is no SOP for CSIA sampling, protocols will be based on the Environmental Isotope Geochemistry Laboratory Instructions for Perchlorate Collection Field Columns (Appendix C of the Field Sampling Plan) with any updates required.

QAPP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS

Document	Where Maintained
Field Records: Field logbooks, COC records/forms, QAPP deviations, communications and reports, photographs, GPS printouts	Maintained at Geosyntec until after completion of the project. Files will be archived at Geosyntec project office and included in reports submitted to USEPA.
Laboratory Analytical Records: Raw and summary data, COC and sample receipt forms, sample and instrument logs	Maintained at Geosyntec until after completion of the project. Files will be archived at Geosyntec project office and included in reports submitted to USEPA.
Data Assessment and QA Records: Data validation report, independent technical review forms, CA communications and reports	Maintained at Geosyntec until after completion of the project. Files will be archived at Geosyntec project office and included in reports submitted to USEPA.
Reports: Drafts, final reports, communications of progress and deviations	Maintained at Geosyntec until after completion of the project. Files will be archived at Geosyntec project office and included in reports submitted to USEPA.

Documents and Records

Documentation is critical for evaluating the success of any environmental data collection activity. The following sections discuss the requirements for documenting field activities and for preparing laboratory data packages. This worksheet also lists documents and reports that will be generated as a result of this project.

Field Documentation

Complete and accurate documentation is essential to demonstrate that field measurement and sampling procedures are carried out as described in this QAPP. Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities. The field logbook will list the contract name and number, the site name, and the names of subcontractors, the service client, and the Project Manager. At a minimum, the following information will be recorded in the field logbook:

- Name and affiliation of all onsite personnel or visitors;
- Weather conditions during the field activity;
- Summary of daily activities and significant events;
- Notes of conversations with coordinating officials;
- References to other field logbooks or forms that contain specific information;
- Discussions of problems encountered and the resolution;
- Discussions of deviations from the QAPP or other governing documents; and
- Description of all photographs taken.

If significant changes to the sampling program are needed because of unanticipated site conditions, this QAPP will need to be amended and submitted to the USEPA Region 2 for review and approval. The field logbook will provide documentation of the deviation from this QAPP and a brief rationale.

QAPP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS (CONTINUED)

Laboratory Documentation and Data Packages

The analytical laboratory performing analysis will provide full data packages, which contain the information required for data validation. The data packages must contain any of the following elements that are applicable to the analysis to enable data validation:

- Title page;
- Table of contents;
- Data package narrative;
- Final data report tables;
- Analytical records:
  - Instrument tuning (GC/MS methods);
  - RTs and RT windows for GC/ECD analyses;
  - Calibration data;
  - Calibration verifications;
  - Surrogate recoveries (GC/MS and GC methods);
  - Internal standard RT checks and area counts for GC/MS analyses and internal standard recoveries for ICP/MS analyses;
  - The QC data required by the analytical method and/or the QAPP (blanks, LCS/LCSD, MS/MSD, and laboratory and field duplicates);
  - Chromatograms for GC/ECD and GC/MS samples, calibrations, and QC samples;
  - Mass spectra for GC/MS analyses;
  - Required supporting information;
  - The sample custody documentation, including sample receipt forms;
  - Sample processing and spiking records;
  - Copies of standard preparation logs for each standard used in sample preparation and instrument calibration;
  - Run logs;
  - Raw data associated with field and QC data;
  - Chromatograms
- Documentation of manual integrations;
- List of current MDLs and RLs for the preparation and analysis methods used for sample processing.

QAPP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS (CONTINUED)

Data Package Format

The analytical laboratory will provide electronic data deliverables (EDDs) for each analytical report. An automated laboratory information management system (LIMS) must be used to produce the EDDs. Manual creation of the deliverable (data entry by hand) is unacceptable. The laboratory will verify EDDs internally before they are issued. The EDDs will correspond exactly to the hard-copy data. No duplicate data will be submitted. EDDs will be delivered in the appropriate format per USEPA Region 2 requirements as applicable. Data will be archived by the laboratory and by the Project Coordinator's office for a minimum of 10 years.

QAPP WORKSHEET #30: ANALYTICAL SERVICES

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Number	Analytical SOP or Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory / Organization (name and address, contact person and telephone number)
Groundwater	Perchlorate	Low	See Worksheet #18	WI9989	28 Days	Eurofins Lancaster Laboratories Environmental, LLC 2425 New Holland Pike Lancaster, PA 17601 (717) 556-7290	SGS North America 2235 US Highway 130 Dayton, NJ 08810 (732) 329-0200
Groundwater	Nitrate	Low		WI11626	Standard		
Groundwater	Sulfate	Low		WI11626			
Groundwater	Orthophosphate as Phosphorous	Low		WI11511			
Groundwater	Alkalinity	Low		WI11475			
Groundwater	TOC	Low		WI11637			
Groundwater	TDS	Low		WI11597			
Groundwater	Sulfide	Low		WI11483			
Groundwater	Iron (Total and Dissolved)	Low		WI11933			
Groundwater	Methane	Low		WI9015178			
Groundwater	Ethane	Low		WI9015178			
Groundwater	Ethene	Low		WI9015178			

Acronym list

DOC - Dissolved Organic Carbon
NA - Not Applicable
SOP – Standard Operating Procedures
TDS – Total Dissolved Solids
TOC – Total Organic Carbon

QAPP WORKSHEET #30: ANALYICAL SERVICES (CONTINUED)

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Number	Analytical SOP or Method	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory / Organization (name and address, contact person and telephone number)
Groundwater	CSIA	Low	See Worksheet #18	ESTCP: Guidance Manual for Forensic Analysis of Perchlorate in Groundwater using Chlorine and Oxygen Isotopic Analyses[1]	Standard	Environmental Isotope Geochemistry Laboratory: University of Delaware, 221 Academy St, ISE lab 458, Newark DE 19716 (302) 831-8022	NA
Groundwater	Gene-Trac®	NA	See Worksheet #18	Gene-Trac®	Standard	SiREM	NA

1. There is no SOP for CSIA sampling, protocols will be based on the provided guidance document with any updates required.

Acronym list

DOC - Dissolved Organic Carbon
NA - Not Applicable
SOP – Standard Operating Procedures
TDS – Total Dissolved Solids
TOC – Total Organic Carbon

QAPP WORKSHEET #31: PLANNED PROJECT ASSESSMENTS

Assessment Type	**Frequency**	**Internal or External**	**Organization Performing Assessment**	**Person(s) Responsible for Performing Assessment** (title and organizational affiliation)	**Person(s) Responsible for Responding to Assessment Findings** (title and organizational affiliation)	**Person(s) Responsible for Identifying and Implementing Corrective Actions (CA)** (title and organizational affiliation)	**Person(s) Responsible for Monitoring Effectiveness of CA** (title and organizational affiliation)
Offsite Laboratory Technical Systems Audit	Per Laboratory QA Manual	Internal	Eurofins Lancaster Laboratories Environmental	Per Laboratory QA Manual	Per Laboratory QA Manual	Laboratory Personnel	Per Laboratory QA Manual
Data Quality Assessment (data validation reports)	Upon receipt of analytical data packages	Internal	Geosyntec	Analytical Data QA Manager	Laboratory PM, Eurofins Lancaster Laboratories Environmental	Laboratory	Analytical Data QA Manager

Acronym list
QA – Quality Assurance

QAPP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

Assessment Type	**Nature of Deficiencies Documentation**	**Individual(s) Notified of Findings** (name, title, organization)	**Timeframe of Notification**	**Nature of Corrective Action Response Documentation**	**Individual(s) Receiving Corrective Action Response** (name, title, organization)	**Timeframe for Response**
Offsite Laboratory Technical Systems Audit	Internal Audit Report	Laboratory Manager/ Laboratory Technical Director/ Laboratory Operations Manager	Annual audit	Per Individual Laboratory QA Manual	Analytical Data QA Manager	Per Individual laboratory QA Manual
Data Quality Assessment	Data Validation Report	Project QA Manager- Livia Capaldi	Upon receipt of analytical data package	Corrective Action from Laboratory	Project Manager- Seth Kellogg Project QA Manager- Livia Capaldi	Within two weeks of issuance of DQAR

Acronym list
DQAR – Data Quality Assessment Report
QA – Quality Assurance

QAPP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES (CONTINUED)

ASSESSMENT

This worksheet addresses assessment of the effectiveness of the project implementation and the associated QA/QC activities.

Field Assessment and Response Actions

To monitor the capability and performance of the field activities, field inspections will be performed as follows.

The Field Manager will supervise work activities and ensure that they are performed in accordance with plans and specifications. Any problems or concerns will be immediately discussed with the Geosyntec project manager, the client respondent and EPA Region 2 RPM as appropriate. An appropriate corrective action (CA) developed, reviewed and implemented. The CA will be documented.

Equipment Inspections

Documented inspections will be performed daily on all equipment prior to and during their use to ensure the equipment is in safe operating condition. Field Personnel will perform these inspections and will alert the field manager immediately if an issue arises.

Preventative maintenance procedures recommended by the manufacturer will be followed. Any equipment found to be unsafe will be flagged and its use prohibited until unsafe conditions have been corrected. Replacement equipment will be delivered to site as quickly as possible if a piece of equipment is discovered to be faulty.

Verification and Testing Procedures

Non-conformance/CA

Non-conforming items and activities are those that do not meet the project requirements. When such a condition is identified, Geosyntec will implement a CA program to:

- Document the non-conforming item or procedure and determine the cause of the non-conformance and its effect on project performance and the integrity of completed work;
- Correct or replace the non-conforming item in the most efficient and effective manner; and
- Verify and document that the corrective action taken is successful.

Documentation of Non-Conforming Items

The Field Manager will document any non-conforming item in the field logbook. This list will clearly state what is out of compliance, the date the noncompliance was originally discovered, and the date the work was corrected.

QAPP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES (CONTINUED)

Implementation of CA

Geosyntec will stop work on any item or feature pending satisfactory correction of the deficiency noted by the Project Manager or the EPA Region 2 RPM. The Project Manager and Field Manager will have the authority to stop work until CAs are implemented. In some cases, the CA may be obvious and may be implemented immediately upon identification of the non-conformance. Others may require additional input from technical and/or operations staff, additional equipment and/or materials, or changes in existing structures or completed work. The Project Manager and Field Manager will not allow work to be added to or built upon non-conforming work unless the EPA Region 2 RPM concurs that the correction can be made without disturbing continuing work.

Verification and Documentation of CA

Non-Conformance/QC Reporting

A non-conformance is defined as an identified or suspected deficiency or discrepancy with regard to an approved document (e.g., improper sampling procedures, improper instrument calibration, calculation error); or an item where the quality of the end product itself or subsequent activities using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with the established plans or procedures.

Any team member engaged in project work that discovers or suspects a non-conformance is responsible for informing the Project Manager or Field Manager. The Project Manager will evaluate each non-conformance and provide a disposition, which describes the actions to be taken and notify the EPA Region 2 RPM per the communication pathway time frame specified by this QAPP.

The Project Manager or Field Manager will verify that no further project work that is dependent on the non-conforming item or activity is performed until the situation has been corrected back to the original condition intended by the project documentation. Documentation of the non-conformance and CA, along with the appropriate verification and approval signatures, will be included in the project file. Copies of the non-conformances will be maintained by the Project Manager.

The Field Manager will verify successful completion of CAs for non-conformances on a follow-up inspection. The Weekly Activity Report will reflect all CAs completed. The Field Manager will also update the re-work item list with the CA taken and the date the CA was completed. Recurring non-conformances of similar nature will be investigated to determine the root cause of the problem so as to eliminate or minimize future occurrences of the non-conformance.

INTERNAL LABORATORY AUDITS

As part of its QA program, the laboratory QA manager will conduct audits of the analytical systems to verify that the systems are working properly, and personnel are adhering to established procedures and documentation practices. These audits will also assist in determining or detecting where problems are occurring. In addition to conducting internal audits, as part of its established QA program, the laboratory is required to take part in regularly scheduled semi-annual performance evaluation (PE) studies and laboratory audits from state and federal agencies, as defined by the agencies. Each laboratory selected to support this project must maintain current NELAP accreditation.

QAPP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES (CONTINUED)

Laboratory CAs

If a particular laboratory analysis is deemed "out of control," CA will be taken by the laboratory to maintain continued data quality. Each laboratory must adhere to their in-house CA policy.

QAPP WORKSHEET #33: QA MANAGEMENT REPORTS TABLE

Type of Report	**Frequency** (Daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (Project Role)
Daily Activity Reports	Daily throughout duration of field activities	Daily	Field Manager	Project Manager Project File
Weekly or Task Activity Reports	Weekly or following the completion of a field event	Within two days of the completion of a task or if a task is expected to take more than one week then a summary at the end of each week of work	Field Manager	Project Manager Project file
Data Validation Reports to be included in Final Project Report	On-going upon receipt of data deliverables	Per project schedule	Analytical Data QA Manager	Project Manager EPA Region 2 Remedial Project Manager Project file
Corrective Action Reports	Generated on the resolution of identified discrepancies in the field	Immediately upon completion	Team member identifying non-conforming activity or item Project Manager	EPA Region 2 Remedial Project Manager Project file
Final Project Report	At the completion of the assigned project tasks	Per project schedule	Project Manager	EPA Region 2 Remedial Project Manager Project file

QAPP WORKSHEET #33: QA MANAGEMENT REPORTS TABLE (CONTINUED)

Periodic QA Management reports ensure that managers and stakeholders are updated on project status and the results of all QA assessments. Efficient communication of project status and problems allows Project Coordinators to implement timely and efficient corrective actions so that the data meets the DQO requirements for the project. EPA Region 2 will receive several types of management reports. These will include the results of any CA items and data validation reports. In addition, each report will contain a section on QA. Problems or issues that arise between regular reporting periods may be identified to program management at any time. Information included in a progress report will include but not be limited to the following:

- Results of technical systems audits conducted during the period, as applicable.
- An assessment of any problems.
- A listing of the non-conformance reports including Stop-Work Orders issued during the period, related CA undertaken, and an assessment of the results of these actions.
- Identification of significant QA problems and recommended solutions, as necessary.

Final Project Report

The issues listed in the Worksheet #33 table will be addressed in the QA management reports (as attachments to the final project report) or the QA section of the final project report. The final project report will also address additional data quality concerns, including the following:

- Narrative and timeline of project activities.
- Summary of DQO development.
- Reconciliation of project data with DQOs.
- Summary of major problems encountered and their resolution.
- Data summary, including tables, charts, and graphs with appropriate sample identification or station location numbers, concentration units, percent solids (if applicable), and data quality flags.
- Conclusions and recommendations

QAPP WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS

Verification Input	Description	Internal/External	Responsible for Verification
Planning Documents	Project Planning documents will be evaluated prior to implementation. Examples of items for review will include designs, specifications, health and safety procedures, and work plans in the list of reviewed items. QAPP review items will include personnel, training, laboratories, methods, SOPs, performance requirements, DQOs, forms, QAPPs, location maps, naming conventions, and project specific analytes.	I/E	Project Manager Analytical Data QA Manager Field Manager EPA Region 2 Remedial Project Manager
Field Activity Documentation	The Field Manager will review all documentation recorded by the field team during all field activities. This will include field log books, field data forms (electronic and paper), calibration records, sampling location plans, decontamination records, and daily reports.	I	Field Manager
Field Data	The data generated in the field to support the project will be checked as completed against the requirements of the Project planning documents, specific data collection requirements and applicable field SOPs. The data will be reviewed by the technical lead(s) prior to being included in the final report	I	Field Manager Leader (designated during activity)
COC Documentation	The COC documents will be peer-reviewed in the field prior to shipping of samples. The COC will also be reviewed upon receipt by the laboratory personnel and again by the data reviewers and data validation team upon receiving the analytical data packages.	I/E	Field Manager Task Leader (designated during activity) Analytical Data QA Manager Laboratory Sample Receiving personnel and Laboratory PM
CA and Non-Conformance documentation	Field CA and non-conformance reports from the laboratory will be checked as CA completed. CA taken by the laboratory will be evaluated by the Analytical Data QA Manager. CA completed by the field team will be evaluated by the Field Manager.	I	Project Manager Analytical Data QA Manager Field Manager Project QA Manager

QAPP WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS (CONTINUED)

Verification Input	Description	Internal/External	Responsible for Verification
Analytical Data Packages	Analytical data results will be checked as completed against the requirements of the QAPP, specific method requirements and laboratory SOPs. Analytical data packages will be reviewed by the laboratory prior to release and by the data validation team upon receipt of the data.	I	Analytical Data QA Manager
EDDs	The EDDs will be developed and provided by the laboratories. EDDs will be text files. Concentration and detection limit data will be delivered as string (as opposed to numeric) field types to ensure that the precision (i.e., number of significant digits) intended by the laboratory is represented in the EDDs. EDDs will be reviewed by the laboratory prior to release of the data and by data management and the data validation team upon receipt.	I	Field Manager Analytical Data QA Manager Laboratory Data Base Manager
Quality Control Summary Report	A summary of the laboratory QC sample results will be verified for completeness by the QA team upon receipt of data packages from the laboratory.	I	Analytical QA Manager Field Manager
Data Handling	The entry of data into the database will be evaluated for completeness and accuracy.	I	Field Manager Analytical Data QA Manager Geosyntec Database Manager

Acronym list
COC – Chain of Custody
CA - Corrective Action
DQO - Data Quality Objective
EDD – Electronic Data Deliverables
SOP – Standard Operating Procedures
QA – Quality Assurance

QAPP WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS (CONTINUED)

Step IIa / IIb	Data Validation Input	Description	Responsible for Data Validation
IIa	Methods	Check that the methods used were those specified by the QAPP.	Data Validation Chemist/ Geosyntec Validation Team, Field Manager
IIa/IIb	Performance Requirements	Check that the performance requirements specified by the QAPP are met.	Data Validation Chemist/ Geosyntec Validation Team, Field Manager
IIa	Report Forms	Check that the report forms are filled out completely and as required by the QAPP, method, or guidance documents.	Data Validation Chemist/ Geosyntec Validation Team, Field Manager
IIa	Sampling plans, location maps, grids, and sample ID numbers	Check that the specifications for these items were met as described by the project planning documents and work instructions.	Field Manager, Project Manager, Sampling Team peer review
IIa	SOPs (sampling and analytical)	Check that the requirements as specified by these documents were met and that the methods and SOPs referenced and contained in the QAPP were applied to the data.	Laboratory personnel, Data Validation Chemist/Geosyntec Validation Team, Field Manager
IIa	Project specific analytes	Check that the project specific analytes were reported as listed in the planning documents, specifically the QAPP.	Laboratory personnel, Technical PM, Data Validation Chemist/Geosyntec Validation Team
IIa/IIb	All required elements of the data package	Check that the required reporting elements are present in the laboratory data package.	Laboratory personnel, Data Validation Chemist/Geosyntec Validation Team

QAPP WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS (CONTINUED)

Step IIa / IIb	Data Validation Input	Description	Responsible for Data Validation
IIa/IIb	Sampling/Field documents	Check that the required criteria and specifications for field practices surrounding sample collection, shipping, and handling are met as specified by the project planning documents. The field documentation will be reviewed, including, but not limited to: COCs, communication logs, CA reports, documentation of field and method variances, documentation of internal QA review, EDDs review, field logs, forms, and notebook review, field calibration records, and daily field reports.	Field Manager, Project Manager
IIa/IIb	External Reports	Check that external reports created for and by the project, as applicable, such as external audit reports, laboratory assessments, performance testing results, and NELAP accreditation support the requirements of the QAPP.	Project Manager, Project QA Manager

QAPP WORKSHEET #35: DATA VERIFICATION PROCEDURES

Data Verification

During the data verification process, the laboratory data for each analytical test will be reviewed to evaluate the completeness of the data set with respect to each reference method and/or to the project requirements. This review will include the data received from the laboratory for data associated with the Operable Unit 3 groundwater investigation. Depending on the level of receivables and the stage of data validation required, these records should include the sample preparation procedure, instrument calibration data and continuing calibration data, project sample and QC sample results, sample identifications, and COCs. These records should also include the completion of the records to identify the analyst(s) who performed the testing and the dates and times of sample preparation and analysis. Depending on the level of validation required, the type of calculation may be reviewed for accuracy. It is the job of the data validator to thoroughly review the data package and to record any deviations that may have occurred. It is the responsibility of the assigned laboratory personnel to thoroughly review the data package and to record any deviations that may have occurred in the case narrative. No data will be released to Geosyntec until the internal review and approval processes are complete.

Data Review Process (Steps I, IIa, and IIb)

Prior to release of the data to Geosyntec, the analytical data will be verified by the responsible laboratory. Upon receipt of the analytical data, the data validator will perform the appropriate stage of data validation, checking the compliance, comparison and usability of the data during the data validation process.

Data Review Process Steps		Step I Verification	Step IIa Compliance	Step IIb Comparison	Step III Usability
Planning Documents					
1	Evidence of required approval of plan (QAPP)	X			Uses Outputs from Previous Steps
2	Identification of personnel (those involved in the project and those conducting verification steps)	X			
3	Laboratory Name	X			
4	Methods (sampling and analysis)	X	X		
5	Performance requirements (including QC criteria) for all inputs	X	X	X	
6	Project quality objectives	X	X	X	

QAPP WORKSHEET #35: DATA VERIFICATION PROCEDURES (CONTINUED)

Data Review Process Steps		Step I Verification	Step IIa Compliance	Step IIb Comparison	Step III Usability
Planning Documents (continued)					
7	Reporting forms	X	X		Uses Outputs from Previous Steps
8	Sampling plans, location, maps, grids, and sample ID numbers	X	X		
9	Site identification	X	X		
10	SOPs (sampling and analytical)	X	X		
11	Staff training and certification	X	X		
12	List of project-specific analytes	X	X		
Analytical Data Package					
13	Case narrative	X	X		Uses Outputs from Previous Steps
14	Internal laboratory COC	X	X		
15	Sample condition upon receipt, and storage records	X	X		
16	Sample chronology (time of receipt,	X	X		
	extraction, and analysis				
17	Identification of QC samples (sampling or lab, temporal, and spatial)	X	X		
18	Associated (batch or periodic) PT sample results	X	X	X	
19	Communication Logs	X	X		
20	Copies of laboratory notebook, records, prep sheets	X	X		
21	CA Reports	X	X		
22	Definitions of laboratory qualifiers	X	X	X	
23	Documentation of laboratory method deviations	X	X	X	
24	Documentation of individual QC results (e.g., spike, duplicate, LCS)	X	X	X	

QAPP WORKSHEET #35: DATA VERIFICATION PROCEDURES (CONTINUED)

	Data Review Process Steps	Step I Verification	Step IIa Compliance	Step IIb Comparison	Step III Usability
Analytical Data Package (continued)					
25	Documentation of laboratory method deviations	X	X	X	Uses Outputs from Previous Steps
26	EDDs	X	X		
27	Instrument Calibration Reports	X	X	X	
28	Laboratory name	X	X		
29	Laboratory sample identification numbers	X	X		
30	QC sample raw data	X	X	X	
31	QC summary report	X	X	X	
32	Raw data	X	X	X	
33	Reporting forms, completed with actual results	X	X	X	
34	Signatures for laboratory sign-off (e.g., laboratory QA/QC Manager)	X	X		
35	Standards traceability records (to trace standard source from National Institute of Standards and Technology (NIST), for example; completed during Stage 4 data validation)	X	X	X	
Sampling Documents					
36	COC	X	X		Uses Outputs from Previous Steps
37	Communication Logs	X	X		
38	CA results	X	X		
39	Documentation of CA results	X	X	X	
40	Documentation of deviation from methods	X	X	X	
41	Documentation of internal QA review	X	X	X	
42	EDDs	X	X		
43	Identification of QC samples	X	X	X	

QAPP WORKSHEET #35: DATA VERIFICATION PROCEDURES (CONTINUED)

Data Review Process Steps		Step I Verification	Step IIa Compliance	Step IIb Comparison	Step III Usability
Sampling Documents (continued)					
44	Meteorological data from field (e.g., wind, temperature)	X	X	X	Uses Outputs from Previous Steps
45	Sampling instrument decontamination records	X	X		
46	Sampling instrument calibration logs	X	X		
47	Sampling Location and Plan	X	X	X	
48	Sampling notes and drilling logs	X	X	X	
49	Sampling report (from Field Manager to Project Manager describing sampling activities)	X	X	X	
External Reports					
50	External audit report	X	X	X	Uses Outputs from Previous Steps
51	External proficiency testing sample results	X	X		
52	Laboratory certification	X	X		
53	Laboratory QA plan	X	X		
54	MDL study information	X	X	X	
55	NELAP accreditation	X	X		

QAPP WORKSHEET #36: DATA VALIDATION PROCEDURES

Step IIa / IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa/IIb	Groundwater	Analyses listed in WS#15 of this QAPP	Low/Standard	Criteria cited in the QAPP, method and SOP criteria, current National Functional Guidelines for Data Validation, and EPA Region 2 Quality Assurance Guidance and Standard Operating Procedures. Definitive data are required for the EPA approved analytical tests used for measuring groundwater, at the site.	Data Validation Chemist/Geosyntec Validation Team

Data Validation

Stage 2A data validation will be performed on 90% of the data associated with the remedial investigation and risk assessment, with the remaining 10% validated at Stage 4. During data validation, the evaluation of the data will extend beyond method, procedural, or contractual compliance (verification) to check the analytical quality of the specific data set. The data will be evaluated with regard to compliance with the DQOs and measurement quality objectives. During data validation, data validation qualifiers will be assigned to provide the basis of describing data quality. Should non-conformance issues be generated from the laboratory, the data validation procedure evaluates the impacts of the nonconformance(s) on the quality and usability of the data set.

Step IIa denotes a list of data validation activities which include the following and are associated with methods, procedures, and contracts (MPC):

- Data Deliverables – Check that the required information on sampling and analysis are provided.
- Analytes – Check that the appropriate analytes were reported, as required.
- COC – Evaluate traceability of data and examine against procedural requirements.
- Holding times – Check analysis holding times.

QAPP WORKSHEET #36: DATA VALIDATION PROCEDURES (CONTINUED)

- Sample Handling – Check that sample preservation, handling, and storage procedures were met.
- Analytical Methods and Procedures – Evaluate whether the required methods and procedures were performed.
- Data Flags – Check that the laboratory flags were defined and used correctly.
- Laboratory Transcription – Check accuracy of transcription, where applicable.
- Standards – Check that standards are traceable and meet project and contract requirements; this is completed as part of Stage 4 data validation.

Step IIb denotes a list of data validation activities which include the following and are associated with comparison with MPC in the QAPP:

- Data Deliverables and QAPP – Check that data report from Step IIa was provided.
- Field Duplicates – Compare results of field duplicates with criteria established in the QAPP.
- Project Quantitation Limits – Check that quantitation limits were achieved as outlined in the QAPP. As part of Stage 4 data validation, check that the laboratory successfully analyzed a standard at the quantitation limit.
- Confirmatory Analysis – Evaluate the agreement of the laboratory results, as appropriate.
- Performance Criteria – Evaluate QC data against project specific performance criteria in the QAPP (i.e., evaluate quality parameters beyond those outlined in the methods).
- Data Qualifiers – Check that the data validation qualifiers applied in Step IIa were those specified in the QAPP and that any deviations were specified.
- Step IIb Data Validation Report – Summarize outcome of comparison of data to MPC in the QAPP, and include qualified data and explanation of the data qualifiers.

QAPP WORKSHEET #37: DATA USABILITY ASSESSMENT

To the extent possible, Geosyntec will follow EPA's data quality assessment (DQA) process to verify that the type, quality, and quantities of data collected are appropriate for their intended use. DQA methods and procedures are outlined in EPA QA/G9-R Data Quality Assessment, A Reviewer's Guide, February 2006. The DQA process includes five steps: 1) review the DQOs and sampling design; 2) conduct a preliminary data review; 3) select a statistical test; 4) verify the assumptions of the statistical test; 5) draw conclusions from the data.

After the data are received from the fixed based laboratory, data validation of the data will occur as described in Worksheet #36. During data validation, where necessary, data validation qualifiers will be applied to the data indicating that it has limited use, should perhaps be examined more closely, or has dramatically failed one or more data quality indicator criteria and has been rejected. This information will be supplied to the project team via a data validation report and to the data manager through updates to the database. A DQA report will be prepared on a periodic basis summarizing the overall quality of the data including field data, field QC data, laboratory QC data, and laboratory data. This will further illustrate the limitations of any qualified data that may have resulted during data validation.

It is incumbent on the project team to then utilize the data in an appropriate manner based on any limitations that have been identified.

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

Data usability is the process of evaluating the data validation results and determining the confidence with which any data point(s) may be used. Usability is determined by evaluating the data validation qualifier applied and the laboratory QC results. Concentration values may be considered to have a high degree of confidence because the associated method performance criteria were achieved. Estimated concentration results are evaluated with respect to the bias contributed to the value by the associated QC result. Bias direction can be estimated for data quality impacts due to surrogate recoveries, MS recoveries, and LCS recoveries. Sample concentration results that are rejected during data validation are not used in the decision-making process and should not be reported.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

Data usability is evaluated with respect to the DQOs developed in this QAPP to check that the opportunity for incorporating unacceptable and manageable error into the decision-making process is minimized to the extent possible. The DQOs for this project are described in the Groundwater Investigation Work Plan.

The analytical data, data validation qualifiers, and QC results will be evaluated to determine the confidence with which the analytical data can be used in the project decision-making process. The criteria used in the data usability summary are presented as follows using the data quality indicator criteria required for this project and measured as precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS).

QAPP WORKSHEET #37: DATA USABILITY ASSESSMENT (CONTINUED)

PARCCS Overview

Introduction

This QA program addresses both field and laboratory activities. QA objectives are formally measured through the computation of performance measures known as data quality indicators (DQIs), which are in turn compared to pre-defined measurement quality objectives (MQOs) specific to the project objectives. The DQIs for measurement data are expressed in terms of PARCCS. Evaluation of DQIs provides the mechanism for on-going control and evaluation of data quality throughout the project and ultimately will be used to define the data quality achieved for the various measurement parameters. The field QA program will be accomplished through the collection of QC samples such as field duplicates and trip blanks. The analytical QA program will be assessed through the internal laboratory QC performed, including method blanks, laboratory control sample (LCS) recoveries, surrogate recoveries, and matrix spike/matrix spike duplicate (MS/MSD) recoveries. The following sections describe the DQIs in greater detail, with a discussion of the associated MQOs.

Precision

Precision refers to the reproducibility or degree of agreement among duplicate measurements of a single analyte. The closer the numerical values of the measurements, the more precise the measurement. Poor precision stems from random errors (i.e., mechanisms, which can cause both high and low measurement errors at random). Precision is usually stated in terms of relative percent difference (RPD), but other estimates, such as the relative standard deviation (RSD), range (maximum value minus minimum values), and relative range are common, and may be used pending review of the data.

Precision will be checked through the collection of field duplicates and the analysis of MS/MSD and LCS/LCSD samples for the work performed at the Site. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision; there are more historical data related to individual method performance, and the “universe” is not limited to the samples received in the laboratory. In contrast, sampling precision is unique to the project. Sampling precision will be measured through the laboratory analysis of field duplicate samples. Laboratory precision will be measured through the analysis of MS/MSD and LCS/LCSD samples.

QAPP WORKSHEET #37: DATA USABILITY ASSESSMENT (CONTINUED)

During the collection of data using field methods and/or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will be determined from duplicate samples and will be expressed as the RPD between replicate/duplicate sample results, computed as follows:

$$RPD = \frac{X_1 - X_2}{(X_1 + X_2)/2} \, x \, 100$$

where *X1* and *X2* are reported concentrations for each replicate sample and subtracted differences represent absolute values. For field duplicates, the precision goal for this project is an RPD of 30%. For laboratory duplicates, the RPD goals are dictated by the specific analytical and laboratory QC acceptance criteria.

Accuracy and Bias

Accuracy refers to the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. The converse of accuracy is bias, in which a systematic mechanism tends to consistently introduce errors in one direction or the other. Bias in environmental sampling can occur in one of three ways; these mechanisms and their associated diagnostic and management methods are as follows:

- High bias, which can stem from cross-contamination of sampling, packaging, or analytical equipment and materials. Cross- contamination is monitored through blank samples, such as equipment blanks, trip blanks, and method blanks. These samples assess the potential for cross-contamination from, respectively, sampling equipment, ambient conditions, packaging and shipping procedures, and laboratory equipment. Data validation protocols described in Worksheet #36 present a structured approach for data qualification based on blank samples.
- Low bias, which can stem from the dispersion and degradation of target analytes (e.g., volatilization of chlorinated solvents during field sampling). The effects of these mechanisms are difficult to quantify. Sampling accuracy can be maximized, however, by the adoption and adherence to a strict field QA program. Specifically, sampling procedures will be performed following standard protocols described in the QAPP. Through regular review of field procedures, deficiencies will be documented and corrected in a timely manner.
- High or low bias may occur due to unacceptable recoveries, unacceptable calibration, or other system control problems. The effects of these mechanisms on analytical accuracy may be expressed as the % recovery of an analyte that has been added to the environmental sample at a known concentration before analysis. Analytical accuracy in the laboratory will be determined through the analysis of LCS/LCSDs and MS/MSDs. As with blank samples, data validation protocols provide a structured formula for data qualification based on high or low analyte recoveries.

QAPP WORKSHEET #37: DATA USABILITY ASSESSMENT (CONTINUED)

Accuracy goals are presented as upper and lower control limits for percent recovery and are generated through the compilation of control charts and referenced in each laboratory method SOP.

Representativeness

Representativeness is defined by the degree to which the data accurately and precisely describe a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. If the results are reproducible, the data obtained can be said to represent the environmental condition. Representativeness is evaluated by collecting sufficient numbers of samples of an environmental medium, properly chosen with respect to place and time. The precision of a representative set of samples reflects the degree of variability of the sampled medium, as well as the effectiveness of the sampling techniques and laboratory analysis.

Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for all data uses in that sufficient amounts of valid data are to be generated.

There are limited historical data on the completeness achieved by individual methods. However, the Contract Laboratory Program data have been found to be 80 to 85% complete on a nationwide basis. The percent completeness for each set of samples will be calculated as follows:

$$\%\ Completeness = \frac{Valid\ Data}{Total\ Data\ Planned}\ x\ 100$$

The QA objective for completeness for all parameters will be 90%.

Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is evaluated through the use of established and approved analytical methods, consistency in the basis of analysis (e.g., wet weight, volume), consistency in reporting units (µg/L, mg/L), and analysis of standard reference materials. By using standard sampling and analytical procedures, data sets will be comparable.

Sensitivity

Sensitivity refers to the minimum magnitude at which analytical methods can resolve quantitative differences among sample concentrations. If the minimum magnitude for a particular analytical method is sufficiently below an action level or risk screening criterion, then the method sensitivity is deemed sufficient to fully evaluate the dataset with respect to the desired reference values. Frequently, risk-based screening levels fall below the sensitivity of even the most sensitive analytical methods. In such cases, it is necessary to review the qualifications of several laboratories, both from the standpoint of sensitivity as well as other DQIs, to select the best laboratory for the project.

QAPP WORKSHEET #37: DATA USABILITY ASSESSMENT (CONTINUED)

The method detection limit (MDL) is a theoretical limit determined through an MDL study, in which the concentration of a spiked solution is analyzed at least seven times. The standard deviation of the recovered concentrations (σrec) is computed and multiplied by the t-distribution value to arrive at the MDL. Method blank results are also used in the MDL calculations. In practice, to allow for matrix interferences variability in instrument control, a reporting limit of 2.5 to 5 times the MDL is typically selected. The reporting limit (RL) used for each analyte must be supported by an initial calibration that incorporates one or more calibration standards with the concentrations at or below the reported RL.

Analytical sensitivity is readily evaluated by comparing method reporting limits to risk-based screening values. The results of this analysis are presented in Worksheet #15, which demonstrate the suitability of the selected methods to the project requirements.

Identify the personnel responsible for performing the usability assessment:

Data usability is first evaluated by the data validation team, the analytical quality assurance manager, and the laboratory performing the fixed base analysis. Usability of data collected in the field is first determined by the field team and Field Manager. Once the data are validated the usability of the data are determined by the project team, specifically the technical leaders for the project and the Project Manager.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

Data usability will be documented through validation reports as well as through the issuance of data quality assessment reports (DQARs), which will summarize how the data reflect the specific criteria for the data quality indicators assigned to the project.

APPENDIX C
Standard Operating Procedures

Written by: Lauren Wellborn Date: 2/24/2014
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STANDARD OPERATING PROCEDURE NO. 101
FIELD DOCUMENTATION, SAMPLE DESIGNATION, CUSTODY AND HANDLING PROCEDURES

SECTION 1 INTRODUCTION

1.1 Objective

The objective of this standard operating procedure (SOP) is to maintain the integrity of each sample from the time of collection to the point of data reporting must be maintained throughout the study. Proper record keeping will be implemented in the field to allow samples to be traced from collection to final disposition. All information relevant to field operations must be properly documented to ensure that activities are accounted for and can be reconstructed from written records. Several types of logbooks will be used for this purpose and should be consistently used by field crews (e.g., field logbooks, field data sheets). This document describes the procedures to be followed for field documentation, sample designation, handling, and custody.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP),
- Quality Assurance Project Plan (QAPP)
- SOP 102 Procedure to Prepare Samples for Shipment

SECTION 2 FIELD DOCUMENTATION

2.1 Field Documentation

During field sampling events, field logbooks and field data sheets are used to record all daily field activities. The purpose of the field logbook is to document events that occur and record data measured in the field.

Data entry will be made in a bound, waterproof field logbook with consecutively numbered pages using indelible ink for each sampling event; all entries will be signed and dated and no erasures will be made. All corrections should consist of a single line-out deletion, followed by the sampler's initials and the date. The sampler will sign and date the last page at the end of each day, and a line will be drawn through the remainder of the page.

The project name, site name and location, and dates of sampling activity should be written on the cover of the field logbook. If more than one logbook is used during a single sampling event, then the upper right hand corner of the logbook will be annotated (e.g., 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Alternatively, multiple logbooks could be used for different sampling activities (e.g., one logbook for surface water sampling and one for groundwater sampling). When multiple logbooks are used for a single sampling activity (e.g., 2 or more sampling teams operating simultaneously during a single surface water sampling event) logbooks should be annotated alphabetically to indicate which of those books is the primary, secondary, etc. logbook for that sampling activity, followed by the number of the logbook. For example, if surface water sampling requires 3 teams and each have a logbook to record daily activity over the sampling event then the primary book will be labeled "Log Book A-1" and the others as "B-1" and "C-1." When only one team is on site, they will use the primary (A) logbook. Field logbooks will be stored in a secure manner when not in use in the field.

In addition to the field logbook, supplementary field data forms may be used during a field sampling event to record the relevant information (e.g. field calibration forms, groundwater monitoring form). At a minimum, the sampler will record the following information daily in the field logbook or on a field sampling form, as applicable:

- Project name, project location, project number and daily objective;
- Project start date and end date;
- Date and time of entry (24-hour clock);
- Time and duration of daily sampling activities;
- Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change;
- Name of person making entries and other field personnel, including the times that they are present;
- Onsite visitors, if any, including the times that they are present;
- The name, agency, and telephone number of any field contacts;
- The sample number and analysis code for each sample to be submitted for laboratory analysis ;
- All field measurements made, including the time that the measurement was collected;
- The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates;
- Type of sample gear used (e.g., pump type or model, gill net mesh size, size of core barrel);
- The location and description of the work area, including sketches and map references, if appropriate;

- Specific information on each type of sampling activity;
- The sample type (i.e., groundwater, soil, surface sediment), and sample number;
- Cross-references of numbers for duplicate samples;
- A description of the sample (source and appearance, such as soil or sediment type, color, and odor);
- Log of photographs (number taken, photo number on roll or memory card, brief description of photo) taken at the sampling location, if any;
- Variations, if any, from specified sampling protocols and reasons for deviation;
- References to other logbooks used to record information (e.g., field data sheets, health and safety log); and
- The signature of the person making the entry.

Monitoring or sampling equipment information, including installation information, any maintenance performed on each piece of equipment, calibration information, and other observations relating to the operation or condition of the equipment, will be recorded on field forms, in field logbooks, and/or in a separate field logbook maintained for a specific type of monitoring or sampling equipment. Upon completion of the field sampling event, the field team leader will be responsible for submitting all field logbooks and field data forms to the project data manager to be copied. Hard copy and an electronic copy shall be maintained in the project files.

SECTION 3 SAMPLE DESIGNATION AND HANDLING

3.1 Sample Labels

A self-adhesive, non-removable label will be affixed to each sample container and completed with an indelible marker prior to sample collection. Sample labels will contain the following information:

- Site name;
- Project number;
- A unique sample identification number (see QAPP for correct sample designation nomenclature);
- Initials of sample collector(s);
- Time and date collected;
- Analysis required; and
- Sample preservative (if applicable).

If samples are likely to contain high concentrations of VOCs or other analytes, the samples will be identified on the chain-of custody forms. Field duplicate or replicate samples will require special procedures for sample designation to ensure that they are submitted as blind samples to the laboratory. The well identification or sample location will not be included in the sample identification number and the collection time will be left blank but recorded in the field log book. The sample and corresponding field QC sample information will be documented in the field records.

3.2 Sample Handling

Each sample container will be sealed in a separate plastic bag following collection. Samples will then be stored in an insulated cooler containing ice packs or ice sealed in a plastic bag. If samples are not immediately shipped to the laboratory, they may be stored in a secure refrigerator/freezer and maintained at the proper temperature. Samples selected for laboratory analysis will be transferred to insulated coolers for overnight shipment to the laboratory. All samples shipped will be carefully checked against the chain-of-custody form (discussed below). Each cooler will be packed in a manner that will prevent damage to sample containers during shipment in accordance with SOP 102.

3.3 Sample Custody and Documentation

Chain-of-custody forms will be used to trace the possession and handling of all samples, from their collection, through analysis, until their final disposition. These forms will document the names of the relinquishing and receiving parties, the time and date of the transfer of custody, and the reason for the transfer of custody. One chain-of-custody form will accompany each cooler shipped to the laboratory. In the event that multiple coolers of samples are being sent to the same location, a unique, task specific, sample shipment group identifier and the number of coolers will be added to the top and special instructions portions of each chain-of-custody. The identifier will include the sample task (e.g., SW for surface water, SED for sediment), sample shipment group (SSG), date (year followed by day of year), and cooler destination (e.g., PITT for Test America Pittsburgh, NC for Test America North Canton). The chain-of-custody form will be placed in a sealed plastic bag inside the cooler. A custody seal will be placed on each cooler after packing and prior to shipment. For multiple cooler shipments, the sample shipment group identifier listed on the chain-of-custody will be written on the custody seal, as well as the cooler number designation (e.g., cooler 1 of 2, cooler 2 of 2). Shipping of samples to the laboratory will be accomplished by Federal Express or equivalent overnight service. Samples will remain in the custody of the sampling team until custody is relinquished to the courier service that will transfer the samples to the laboratory. Each sample shipment will be tracked via the courier weigh bill number to ensure that prompt delivery of the shipment to the laboratory has occurred.

Upon receipt by the laboratory sample custodian, the Sample Custodian will note on the form whether the custody seal is intact, the cooler temperature, the presence of air bubbles in any of

the water samples submitted for VOC analysis, any damaged sample containers and/or discrepancies between the sample label and information on the form, and sign and date the form. A copy of the chain-of-custody form will then be transmitted to the Project Manager or their designate for their records.

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STANDARD OPERATING PROCEDURE NO. 108
COLLECTION OF GROUNDWATER SAMPLES

SECTION 1 INTRODUCTION

This Standard Operating Procedure (SOP) was prepared to provide instructions for groundwater sampling using the USEPA low-flow with minimal drawdown well purging protocol and sampling with a bailer when non-aqueous phase liquid (NAPL) is present.

1.1 Objective

The objective of groundwater sampling is to obtain a representative sample of groundwater for laboratory analysis of contaminants of concern at a given site. This objective requires that the sample be both free of unsuitable material and be of sufficient quantity and quality for analysis by the selected analytical method.

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP)
- Plus and Barcelona (1996). Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. *EPA Ground Water Issue*. EPA/540/S-95/504
- Quality Assurance Project Plan (QAPP)
- SOP 100 Recording Sample Location with a GPS
- SOP 101 Field Documentation, Sample Designation, Custody and Handling
- SOP 102 Procedure to Prepare Samples for Shipment
- SOP 103 Decontamination Procedure for Sampling Equipment
- SOP 104 Management and Disposal of Investigative Derived Waste
- SOP 110 Water Level Measurement Procedure
- SOP 124 Procedure to Calibrate Field Instrument
- USEPA Method 1669 (USEPA, 1996)

1.3 Equipment

1.3.1 Documentation

- field log forms and applicable supplementary field data forms;
- writing tools (pencils, Sharpie®, etc.);
- bottle labels;
- equipment manuals;
- analysis and sample bottle summary ;
- digital camera;
- water proof field log book; and
- mapping-grade GPS, as described in SOP 100, for recording sample locations or navigating to pre-determined locations.

1.3.2 Storm Gear

- rain gear (i.e., boots, ponchos); and
- flashlights (preferably head flashlight) or work-place lights.

1.3.3 Task-Specific Equipment

- boots, waders, and other personal protective equipment (PPE) as required by HASP;
- gloves: clean, non-talc nitrile;
- water level tape;
- water quality Sondes (YSI 6-series) with flow-through cell and probes for measuring field parameters;
- spare batteries for equipment;
- interface meter
- instrumentation and calibration solutions for field probes;
- decontamination equipment (see SOP 103);
- laboratory-supplied reagent grade water for blank samples (note that different analytical groups may require water prepared and certified by the laboratory to different standards from other analytical groups [i.e., reagent water supplied for trace metals analysis blanks will need to be certified to lower levels of metals than that for regular metals analysis]);
- sample containers and preservatives (see QAPP);
- 0.45-µm, high-capacity water sample filters;

- Teflon-lined tubing, connections, and tools, as appropriate; sufficient tubing to dedicate to each well;
- graduated cylinder or 1-liter bottle and stopwatch;
- 5-gallon bucket and funnel for purge water;
- sorbent pads;
- cable ties;
- hand tools (Allen wrench set, hammer, screwdrivers, pliers, knife, wire strippers, measuring tape);
- paper towels;
- Zip-lock bags;
- trash bags (one for IDW and one for general trash);
- clean plastic sheeting;
- marine vessel;
- wooden stakes and highly visible spray paint;
- peristaltic, bladder, submersible, or Waterra pump capable of a flow rate between 50 and 500 mL/minute and appropriate power supply, including compressor if needed. The pump type will principally depend on the depth to water and well diameter. Bladder or submersible pumps are preferred, peristaltic pumps are acceptable only for wells where the depth to water is less than approximately 25 feet. Waterra pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump;
- bottom-filling Teflon™ bailer;
- SEBS resin tubing – provided by the analytical laboratory and certified as meeting the requirements of USEPA Method 1669 and double bagged;
- fluoropolymer tubing – provided by the analytical laboratory and certified as meeting the requirements of USEPA Method 1669 and double bagged (if using peristaltic pump);
- battery and spare battery to power pump;
- battery charger;
- coolers;
- ice; and
- voltmeter for trouble-shooting peristaltic pump malfunction.

SECTION 2 PROCEDURES

2.1 Pre-Mobilization Activities

1. Obtain the construction, diameter, depth, material, screened interval, and map showing location for each monitoring well to be sampled.
2. Obtain a listing of the parameters that will be measured in the field or laboratory as part of this sampling program including the required analytical method, analytical lab, sample volume, nomenclature, preservative, sample containers and holding time for each parameter as detailed in the QAPP. The parameters that will be measured in the field are the low-flow stabilization parameters including temperature, pH, salinity, specific conductance, oxidation reduction potential (ORP), dissolved oxygen (DO), and turbidity. These parameters will be recorded during low flow purging and immediately prior to collection of samples for laboratory analysis. In addition, certain geochemical parameters, such as ferrous iron, may be measured in the field through test kits. Remaining parameters will be measured in the laboratory.
3. Obtain a listing of the frequency of the applicable field quality control (QC) samples; duplicates, MS/MSD pairs, field blanks, equipment blanks and trip blanks sampling as per the QAPP.
4. Verify that all equipment on order is being shipped to the site.

2.1.1 Sample Container and Tubing Preparation

1. Sample container procurement should be arranged with the analytical laboratory several weeks prior to the event.
2. Field equipment that must be cleaned and provided by a supplier should be ordered several weeks prior to the event.
3. Upon receipt of the cleaned sample bottles from the laboratories, bottles should be inventoried.
4. Equipment blanks should be collected from the tubing provided by the analytical lab if applicable.
5. Powder-free nitrile gloves should be worn whenever handling clean bottles.
6. Containers shall be placed in clean coolers for transport to the field.

2.2 Pre-Sampling Procedures

Several steps are required before sampling any of the wells. These steps ensure that instruments are functioning and properly calibrated and that the necessary equipment has been supplied for efficient and accurate sampling.

2.2.1 Inventory

Verify that the correct equipment has been received by the field site and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the correct number of containers of the proper size and containing the correct preservative if required. To the extent possible, pre-label/tag and bundle sample containers for each well to avoid confusion during sample collection.

Verify that the appropriate PPE and ancillary supplies (e.g., paper towels, decontamination solution) have been received by the field site. The appropriate protective equipment, as specified in the HASP, will be reviewed during a morning tailgate meeting. Contact the field manager or project manager immediately if there are discrepancies.

2.2.2 Calibration

Calibrate the multi-parameter sonde consistent with the manufacturer's specifications before sampling and at the start of each field day. A check of the calibration shall be performed at least once more during the field day. Instruments will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on the applicable field form (e.g. field calibration form). Calibration will also be checked if any readings during sampling are suspect. Calibration procedures are described in SOP 124.

2.2.3 Well Inspection

Inspect the well for the presence of lock and cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in flush mounts. Note any irregularities in the applicable field form (e.g. groundwater sampling field form). If the well casing is damaged and there are anomalies in the calculated water level at the well, then the casing damage may indicate compromised sample quality.

2.3 Well Purging and Sampling

Sampling is performed in teams according to the health and safety protocol for the site. Under most tasks, sampling is performed using a five-step procedure that will be followed upon arrival at each well:

1. Set-up;
2. Purging;
3. Measurement of field parameters and field testing;
4. Sampling; and
5. Clean-up and decontamination.

Detailed procedures for performing each of these steps are provided in the following subsections.

2.3.1 Set-up

All necessary equipment for purging, sampling, and storage will be brought to the well before the well is opened. Equipment will be placed on a clean plastic sheet near the well. General parameters describing the well and field condition (e.g., well identification, depth, weather, date, and time) will be documented on a field data sheet. PPE, as required by the HASP, will be donned prior to opening well. Sampling begins by opening the well and measuring the depth to the water table. The tubing, multi-parameter sonde, and reservoir for purged water are then set up.

2.3.2 Purging by Low Flow Protocol

Wells are purged using the low flow/minimum drawdown protocol as described by Puls and Barcelona (1996) and summarized below. The general procedural requirements for low-flow purging are listed below.

1. Lower the pump slowly down the well, positioning the pump intake at the middle of the well screen and tubing will be connected to a flow-through cell and a discharge line will be run from the flow-through cell to a bucket.
2. Minimize disturbance of the water column in the well by initiating pumping at a low rate (see below). Dedicated tubing (left in-place between sampling events) is also recommended to minimize disturbance to the water column before and during sampling.
3. Begin pumping at a steady rate of 100 mL/min and measure the depth to water frequently (e.g., every minute for the first few minutes) to ensure that less than 0.1 ft of drawdown occurs. The pumping rate may be increased if drawdown is less than 0.1 ft, but the pumping rate will not exceed 500 mL/min. In some silty and/or clayey formations, drawdown may exceed 0.1 ft when pumping at 100 mL/min. If this occurs, refer to Section 2.3.3 Variations from Low Flow Protocol, below, for alternatives to the low flow/minimum drawdown protocol.
4. Field parameters and depth to water will be recorded on field data sheets a minimum of every five minutes while purging or after initial purge, post-purge, and following sample collection. Purging will continue until temperature, pH, salinity, specific conductance, ORP, DO, and turbidity stabilize (three consecutive readings), which is defined as follows:

    - ±0.1 units for pH;
    - ±3% for specific conductance;
    - ±10% for salinity;
    - ±10 mV for ORP;
    - ±10% for temperature;

- ±10% for turbidity; and
- ±10% for DO.

5. DO and turbidity tend to stabilize last and are better measures of sufficient purging.
6. In the case that the above criteria for stabilization are not met before three well volumes have been pumped, then a maximum of five well volumes will be pumped before samples are collected. Also, if stabilization has not occurred after 30 minutes of purging regardless of well volume status, samples will be collected at this point. If the well cannot sustain this purge rate, then the well will be purged dry and allowed to recover prior to sampling.

2.3.3 Variations from Low Flow Protocol

Wells in low-yield formations such as silt or clay soils may not yield sufficient water for purging (e.g., 100 mL/min) without more than 0.1 ft of drawdown. In these cases, a modified low-flow method will be used. Currently, there is no published protocol for sampling low-recharge wells. Two modifications described below have been endorsed at one site by USEPA for sampling and purging wells that yield less than 100 mL/min at a drawdown of 0.1 ft.

Alternative Method 1: Less than half the casing volume is located above the well screen

Purge the well with the pump intake located at the midpoint of the well screen by constant pumping at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. Measure and record the field parameters and water depth at a minimum of five-minute intervals or at the end of every purge cycle, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity). Cease pumping and allow the water level to recover until the standing water column in the well (length from water level to bottom of well) equilibrates to at least 90% of the static water column. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Alternative Method 2: More than half the casing volume is located above the well screen

The well will be purged with the pump intake located at midpoint of the well screen at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. This will remove at least one-half of a casing volume of water from the well. The well is then allowed eight hours to recover, after which time a volume of water equal to the casing volume of the screened interval will be removed, removing approximately a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is to be collected from the midpoint of the screened interval.

Other Modifications to Low Flow Sampling

Other modifications of the low-flow protocol may be required. Low-recharge wells screened across the water table are not amenable to either of the methods described above. It may not be practical to sample extremely low recharge wells using any of the cited modifications, in which case, it will be necessary to evacuate all casing water and re-sample as soon as sufficient recharge has entered the well to provide a sample. A modified approach will be necessary for some of the work plans, as directed within those work plan elements. Data from such wells will be qualified to indicate the potential for sample bias.

2.3.4 Field Measurements

Field parameter measurements will be recorded following parameter stabilization (purging) and before sampling. The pumping rate and sampler intake location in the well are not to be adjusted after purging. The field parameters typically measured are temperature, pH, salinity, specific conductance, ORP, DO, and turbidity.

2.3.5 Sample Collection by Pump

Samples will be collected after field parameters have stabilized and measurements recorded. The pump rate and sample intake location will not be adjusted between purging and sampling. Samples are to be obtained from the influent line (prior) to the flow-through cell (i.e., field parameters cannot be measured during sampling). The following sampling strategy is to be followed at each location in its entirety prior to beginning a new location.

Additionally, all individuals involved in sample collection will be trained by a sampler experienced in the collection method prior to collection of samples.

Sample containers are to be filled in the order listed below as applicable to the task specific analytical program. Note that many sample containers contain preservatives; hence, it is necessary to fill each container carefully enough to avoid or minimize overfilling, which may dilute the preservative to unacceptable levels.

1. If collected, volatile organic compound (VOC) samples will be collected first. Sample containers are to be completely filled so that a positive meniscus forms over the opening of the container. The container lid will be moistened with groundwater and screwed to the container body. The container is then turned upside down and inspected for air bubbles. If air bubbles exist in the container, then it is "topped off" to eliminate bubbles. This procedure is repeated until there are no entrapped bubbles in the container. Filled samples are stored at <6°C but not frozen.
2. Then, if collected, the following samples are collected:

a) Total petroleum hydrocarbons (TPH) – water will be dispensed into two 1,000 mL amber glass bottles without preservative, sealed, and stored at <6°C but not frozen.

b) Polycyclic Aromatic Hydrocarbons (PAHs) – water will be dispensed into two 1,000 mL amber glass bottles without preservative, sealed, and stored at <6°C but not frozen.

c) Semi-volatile organic compound (SVOC) and Polycyclic Aromatic Hydrocarbons (PAH) – water will be dispensed into two 1,000 mL amber glass bottles without a preservative, sealed, and stored at <6°C but not frozen.

d) PCBs and pesticides - water will be dispensed into two 1,000 mL amber glass bottles without a preservative, sealed, and stored at <6°C but not frozen.

e) Metals – groundwater will be split into two portions; one filtered sample and one unfiltered sample. The filtered sample (for dissolved metals analysis) will be field-filtered using a clean, disposable, 0.45-µm filter attached in-line to the sample tubing. Filtered water will be dispensed into a 500 mL wide-mouth plastic bottle with HNO_3 as a preservative to achieve a pH below 2, sealed and stored at <6°C but not frozen. Unfiltered water (for total metals analysis) will be dispensed directly in to a 500 mL wide mouth plastic bottle with HNO_3 as a preservative to achieve a pH below 2, sealed, and stored at <6°C but not frozen.

3. If NAPL mobility characteristics are to be analyzed, the following analyses are to be performed:

a) Fluid Properties: Density via ASTM D1481, viscosity via ASTM D445, interfacial tension and surface tension via ASTM D971 at three different temperatures. These are used in understanding the potential for the NAPL to migrate. Water will be dispensed into a 250 mL glass bottle without a preservative, sealed, and stored at <6°C but not frozen.

b) OILPRINT™: This test follows IP method 318/75M and is a high-resolution chromatographic test for petroleum hydrocarbons (C4 to C35+) fingerprint analysis used for NAPL identification. The type of NAPL will also affect the ability for the NAPL to migrate. Analysis will be from the samples collected for fluid properties.

2.3.6 Sample Collection by Bailer

Groundwater samples collected from wells that are not purged and for which field measurements are not collected, the following procedure is prescribed:

1. Prior to sampling, sorbent pads will be placed around the well to capture potential drips from the sampling activities;

2. Slowly lower a decontaminated interface meter down the well to confirm NAPL presence. Collect and record water and NAPL level measurements according to procedures outlined in SOP 110;
3. Lower a clean dedicated bottom-filling Teflon™ bailer into the groundwater above the NAPL interface. Collect a groundwater sample and slowly raise the bailer out of the well to avoid disturbing the NAPL and without touching the sidewalls to avoid contaminating the sample;
4. Transfer groundwater form bailer into appropriate sample containers as per the QAPP; and
5. Repeat groundwater sample collection until the desired volume for samples is achieved.

Sample containers are to be filled in the order provided in Section 2.3.5. Note that many sample containers contain preservatives; hence, it is necessary to fill each container carefully enough to avoid or minimize overfilling, which may dilute the preservative to unacceptable levels.

2.3.7 Observations During Sampling

Field sampling staff will identify and log any observations into a field notebook or in the applicable field form for each well. These observations include, but are not limited to: excessive bubbling within the tubing or in the sample containers as they are filled; odors such as sulfide; excessive turbidity, solids, or formation of precipitates in the samples; color changes in the water; and unusual sounds made by the equipment.

2.3.8 Storage and Shipping

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at <6°C but not frozen prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. Refer to the SOP 102 for sample shipping.

2.4 Sample Disposition

Samples will be labeled, maintained in custody, and handled in accordance with SOP 101. Samples shall be prepared for shipment in accordance with SOP 102.

2.5 Documentation

Activities conducted as part of this SOP shall be documented in accordance with SOP 101. Documentation shall include a record of daily conditions and activities, calibration activities, sampling activities, and all other information required to be recorded per SOP 101.

2.6 Decontamination Procedures

Equipment will be decontaminated between sample locations. Decontamination shall be performed according to SOP 103. Personnel and PPE decontamination shall be performed in accordance with the HASP.

2.7 Investigative Derived Waste (IDW)

IDW, including decontamination fluids, used PPE, and other IDWs generated during activities associated with this SOP shall be handled and disposed of according to SOP 104.

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STANDARD OPERATING PROCEDURE NO. 110
PROCEDURE TO CALIBRATE FIELD INSTRUMENT

SECTION 1 INTRODUCTION

1.1 Objective

The objective of collecting *in situ* water quality and air quality data is to obtain representative physical/chemical parameters of the waterway being studied. This objective requires that the instrument be calibrated accurately. Therefore, this standard operating procedure (SOP) establishes procedures for calibrating a multiparameter water meter, and a photoionization detector/flame ionization detector (PID/FID).

1.2 Referenced Documents and SOPs

- Health and Safety Plan (HASP)
- Quality Assurance Project Plan (QAPP)
- SOP 103 Decontamination Procedure for Sampling Equipment

1.3 Task-Specific Equipment

- Boots, waders, and other personal protective equipment (PPE) as required by HASP;
- Water quality sondes (YSI 6-series);
- Stainless-steel weights;
- Sample containers;
- Coolers;
- Ice;
- Tape measure;
- Paper towels;
- Trash bags (one for IDW and one for general trash);
- Spare equipment batteries;
- Calibration solutions;

- Laptop computer (for data download, verification of proper data storage on the YSI, and direct data logging) with ECOWIN software; and
- Decontamination equipment (see SOP 103).

SECTION 2 PROCEDURES

2.1 Calibration of Water Quality Sonde

Water quality sondes are to be calibrated at the beginning of each sample day and checked for accuracy at the end of each sample day.

2.1.1 Daily Calibration

Water quality sondes shall be used to monitor *in situ* turbidity levels (in NTU), temperature, dissolved oxygen (DO), pH, conductivity, and oxidation-reduction potential (ORP). Sondes will be calibrated at the beginning of each work day. Calibration will be performed using calibration solutions and procedures prescribed by the manufacturer instructions. The general method of calibration for each sensor is described below.

- DO: two-point calibration including zero and 100% saturation (in air)
- Conductivity: single-point calibration
- Temperature: factory-calibrated (temperatures of all calibration standards should be recorded during calibration)
- pH: two-point calibration including pH values of 4.0, 7.0, or 10.0.
- ORP: single-point calibration
- Turbidity: two-point calibration including standards 0 NTU, 10.0 NTU, 12.7 NTU, 100.0 NTU, 126.0 NTU, 800.0 NTU or 1000.0 NTU

The sonde will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on the applicable field forms (e.g. field calibration form). Calibration will also be checked if any readings during sampling are suspect.

2.1.2 End-of-Day Check

At the end of each day, the sondes used for manual sampling should be checked against known standards to confirm that probes are reading correctly. This is done by submerging the probe in the calibration solution used at the beginning of the day and recording the readings, following equipment decontamination per SOP 103. If the reading is not within the accuracy limits of the probe compared to the calibration value, the information should be recorded in the log book and on the Field Log for the locations visited that day.

2.1.3 Decontamination

The sonde will be decontaminated between each sampling location. Decontamination shall be performed according to SOP 103. Personnel and PPE decontamination shall be performed in accordance with the HASP.

2.2 Calibration of the PID/FID

PIDs/FIDs are to be calibrated at the beginning of each sample day and checked for accuracy at the end of each sample day.

2.2.1 Daily Calibration

A PID/FID equipped with a 10.6 eV lamp shall be used to screen sediment samples for VOC impacts. PID/FIDs will be calibrated in a clean environment at the beginning of each workday using a two point field calibration for zero and span gas. The zero calibration, which is made with fresh air, is followed by a second calibration using a 100 ppm isobutylene gas cylinder. Readings will be recorded and should closely match the respective span gas value. Calibration will adhere to procedures prescribed by the manufacturer instructions.

The PID/FID will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on the applicable field forms (e.g. field calibration form). Calibration will also be checked if any readings during sampling are suspect. The battery should be charged overnight.

2.2.2 End-of-Day Check

At the end of each sampling day, the PID/FID will be checked for accuracy by analyzing fresh air and 100 ppm isobutylene. The readings should be recorded and fall within the accuracy limits of the probe compared to the calibration value. If the readings are outside of the accuracy limits, then it should be noted in the log book and on the Field Log for the locations visited that day.

APPENDIX D
Health and Safety Plan

Geosyntec consultants

engineers | scientists | innovators

HEALTH AND SAFETY PLAN

Shieldalloy Metallurgical Corporation Superfund Site
Operable Unit 3 Perchlorates
Newfield, New Jersey

Prepared for

Shieldalloy Metallurgical Corporation
35 South West Boulevard
Newfield, NJ 08344

Prepared by

Geosyntec Consultants, Inc.
7 Graphics Drive, Suite 106
Ewing, NJ 08628

Project JR0241

May 2019

Geosyntec consultants

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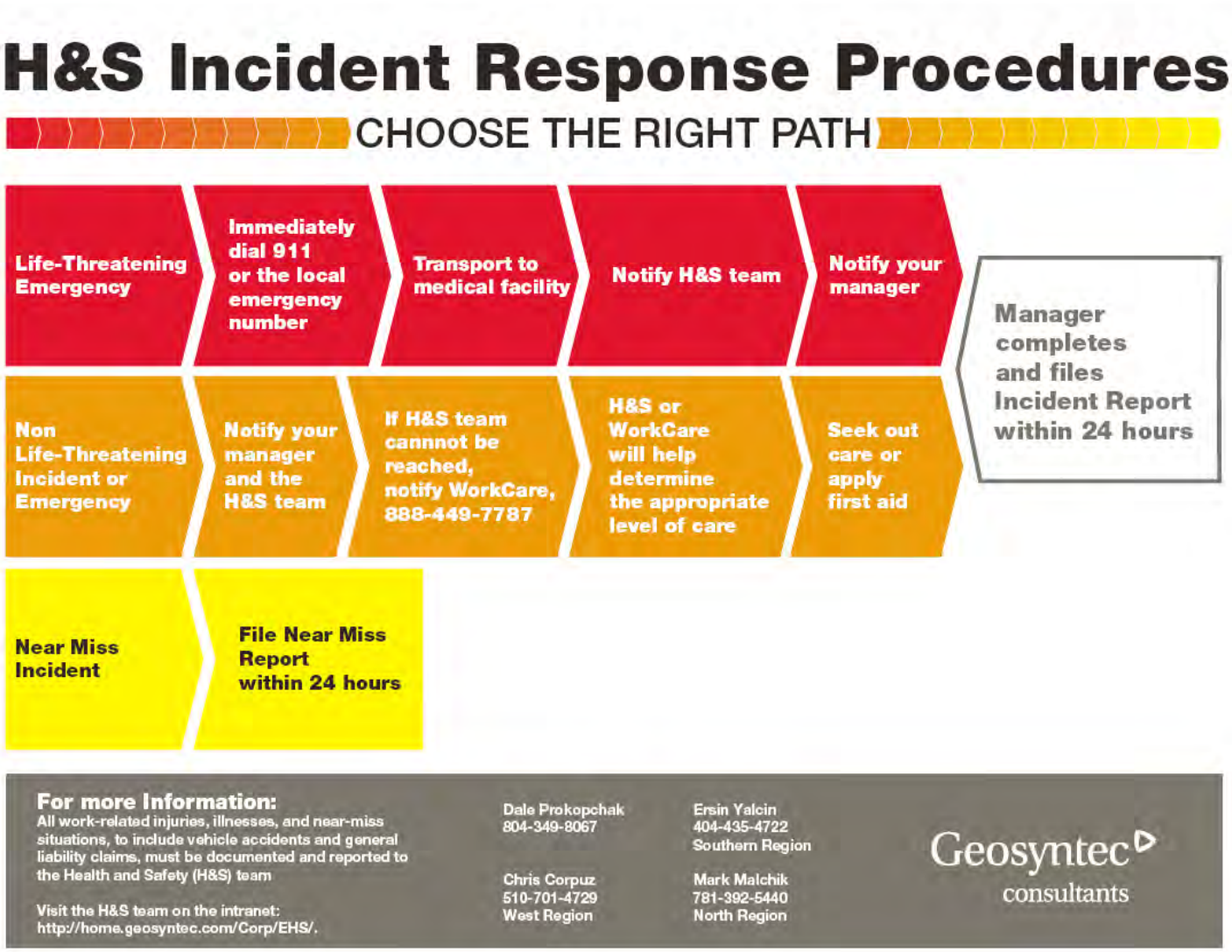
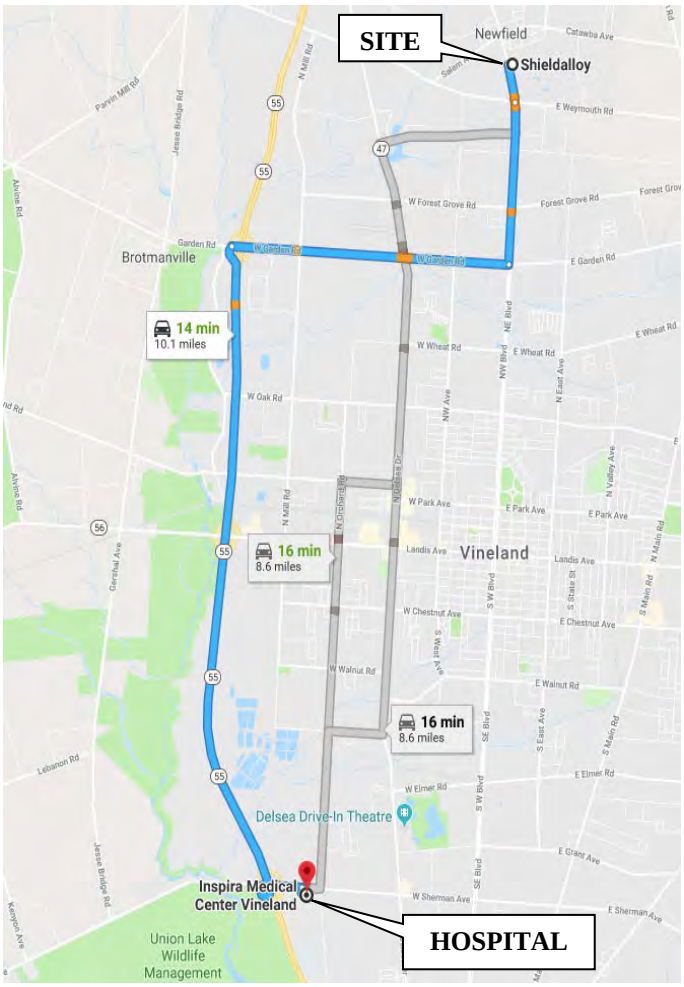
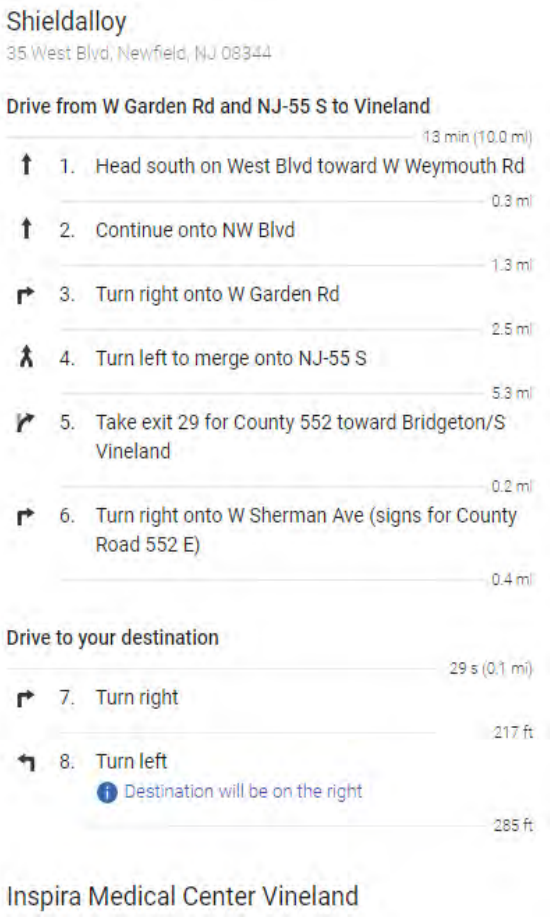
LIST OF APPENDICES

HEALTH AND SAFETY INCIDENT RESPONSE PROCEDURES



ROUTE TO HOSPITAL





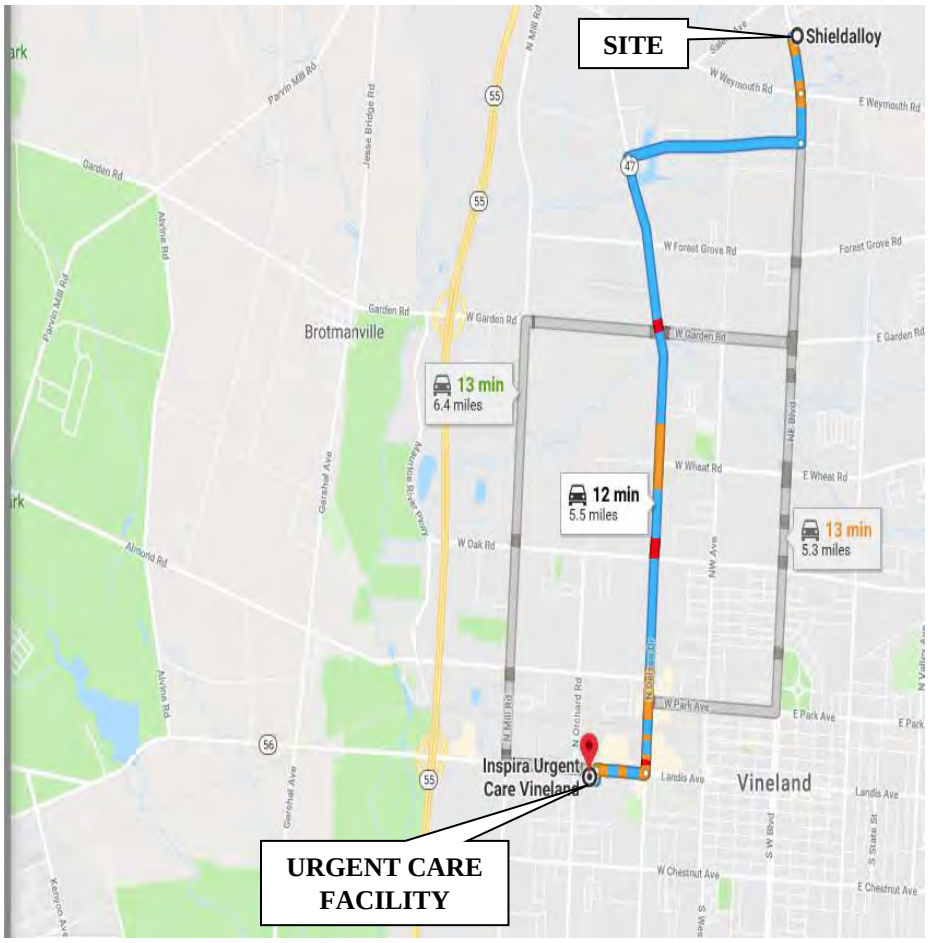
Inspira Medical Center Vineland
10.1 miles, 14 minutes
(856) 641-8000
1505 W Sherman Ave
Vineland, NJ 08360

ROUTE TO URGENT CARE FACILITY

Shieldalloy
35 West Blvd, Newfield, NJ 08344

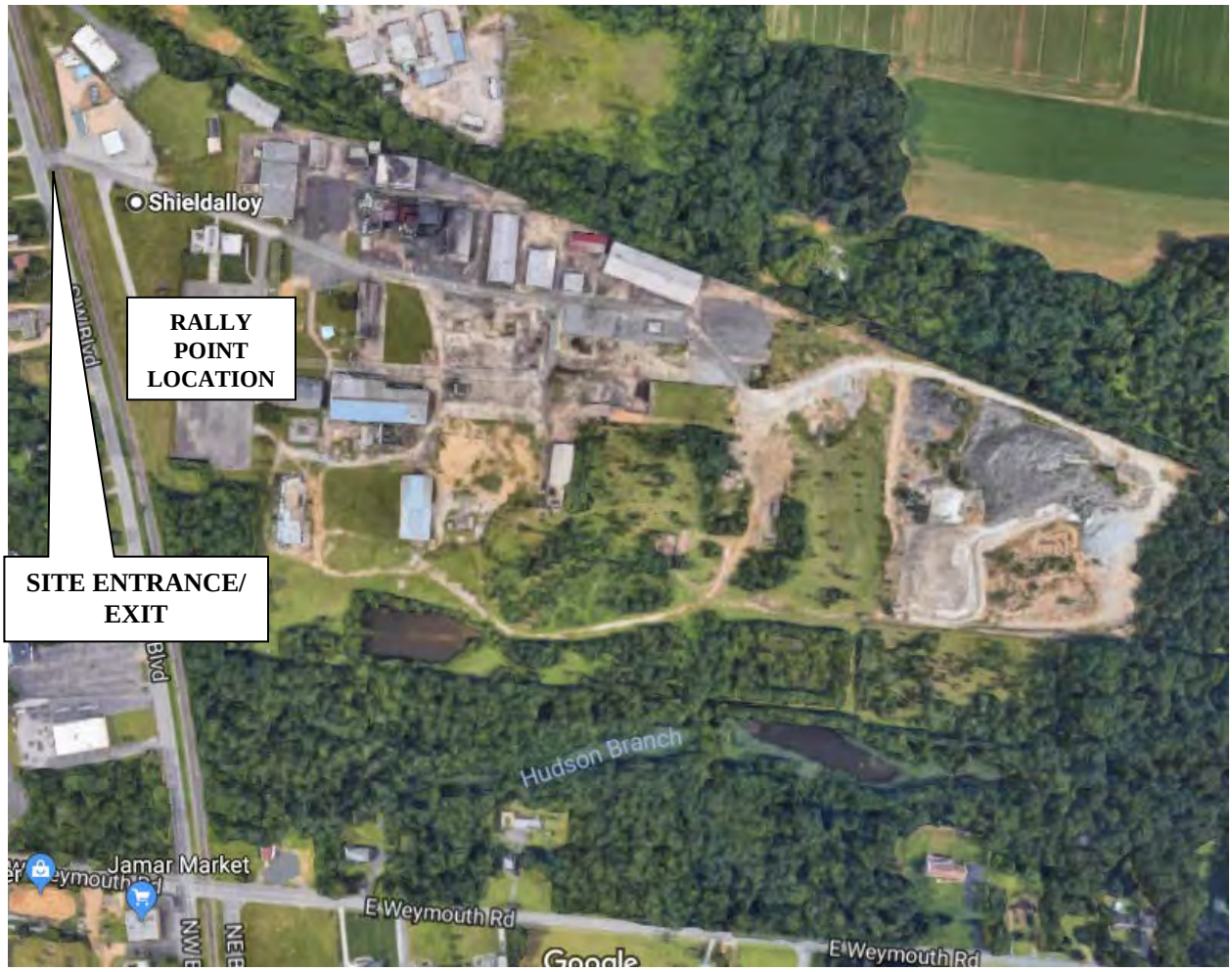
- Take West Blvd to W Arbor Ave in Vineland
  - 1 min (0.6 mi)
  - Head south on West Blvd toward W Weymouth Rd
  - 0.3 mi
  - Continue onto NW Blvd
  - 0.3 mi
  - Turn right onto W Arbor Ave
  - 2 min (1.2 mi)
- Follow N Delsea Dr
  - 7 min (3.6 mi)
  - Turn left onto N Delsea Dr
  - 3.3 mi
  - Turn right onto W Landis Ave
  - 0.3 mi
- Drive to your destination
  - 42 s (0.1 mi)

Inspira Urgent Care Vineland
1297 W Landis Ave, Vineland, NJ 08360



Inspira Urgent Care
5.5 miles, 12 minutes
(856) 507-8548
1297 W Landis Ave
Vineland, NJ 08360

SITE MAP

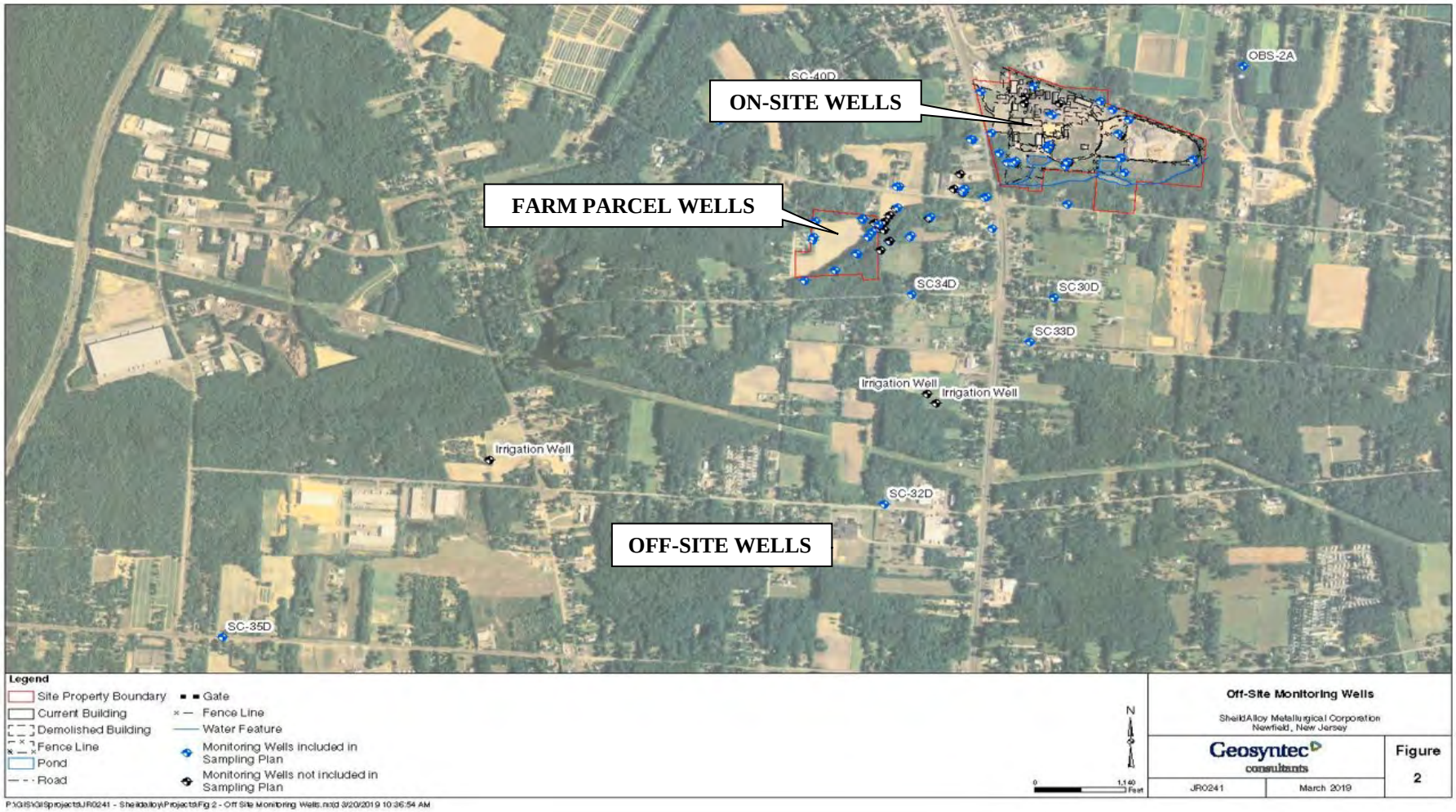


Site Address:

35 South West Boulevard

Newfield, NJ 08344

OFF-SITE MAP


ON-SITE WELLS
FARM PARCEL WELLS
OFF-SITE WELLS
OBS-2A
SC-40D
SC34D
SC30D
SC33D
Irrigation Well
Irrigation Well
Irrigation Well
SC-32D
SC-35D
Legend
Site Property Boundary
Current Building
Demolished Building
Fence Line
Pond
Road
Gate
Fence Line
Water Feature
Monitoring Wells included in Sampling Plan
Monitoring Wells not included in Sampling Plan
N
0
1,140
Feet
Off-Site Monitoring Wells
Sheild Alloy Metallurgical Corporation
Newfield, New Jersey
Geosyntec consultants
Figure
2
JR0241
March 2019
P:\GIS\GISprojects\JR0241 - Sheildalloy\Projects\Fig 2 - Off Site Monitoring Wells.mxd 3/20/2019 10:36:54 AM

1. INTRODUCTION

This Site-specific Health and Safety Plan (HASP) was prepared to address project-specific hazards known or suspected to be present associated with the existing conditions and work to be performed at Operable Unit (OU) 3 of the Shieldalloy Superfund Site in Newfield, New Jersey (the Site). This HASP was prepared to meet the requirements specified in Occupational Safety and Health (OSHA) Hazardous Waste Operations Emergency and Response (HAZWOPER) program, Geosyntec Consultants, Inc. (Geosyntec)'s Health and Safety (H&S) Procedure HS 301, and the H&S requirements of Shieldalloy Metallurgical Corporation (SMC).

2. SIGNATURES

2.1 Preparers and Reviewers

This HASP must be maintained on-Site when field work is being performed. The Site Health and Safety Officer (SHSO) can change or amend this document, in agreement with the Health and Safety Coordinator (HSC) or Project Manager (PM). Amendments (e.g., changes in personal protective equipment, addition of tasks, etc.) must be documented in Section **Error! Reference source not found.** and in Appendix A. This HASP must be reviewed and amended on an annual basis for projects lasting more than one year.

Prepared by:

SHSO	Date

Reviewed by:

HSC	Date

Approved by:

Project Manager	Date

This HASP has been given to the following H&S approved subcontractor(s).

Subcontractor	Representative	Date
Subcontractor	Representative	Date
Subcontractor	Representative	Date

2.2 Site Workers

This HASP must be reviewed by personnel prior to Site work. Workers not in attendance at the initial meeting must be trained by the SHSO on the information covered in the pre-entry briefing. After reading the HASP and attending a pre-entry briefing, Geosyntec employees and other parties covered under this HASP must sign the following acknowledgment statement.

"I have read, understand, and will perform my work in accordance with the information set forth in this HASP."

Signature	Printed Name	Date

3. EMERGENCY CONTACT INFORMATION

Contact	Telephone Numbers	
	Office	Alternate (Type)
Fire Department	(856) 697-4851	
Police Department	(856) 694-1415	
Site Emergency Response (if applicable)	911	
Hospital – Inspira Medical Center Vineland	(856) 641-8000	
Urgent Care – Inspira Urgent Care	(856) 507-8548	
Director of H&S – Dale Prokopchak	(804) 332-6376	(804) 349-8067 (Cell)
H&S Regional Manager – Mark Malchik	(978) 206-5777	(781) 392-5440 (Cell)
Project Manager – Seth Kellogg	(609) 493-9018	(732) 354-8463 (Cell)
Site Health & Safety Officer – Jessica Evans	(609) 493-9003	(609) 379-9685 (Cell)
H&S Coordinator – Matt Mraw	(609) 493-9004	(609) 462-1198 (Cell)
Principal- or Associate-in-Charge – John Persico	(609) 493-9008	(609) 903-6227 (Cell)
Utility Emergencies	811	
Work Care	(888) 449-7787	(714) 978-7488
Facility Contact – John Hunt	(484) 582-3519	(617) 957-5961 (Cell)
Client Contact – John Hunt	(484) 582-3519	(617) 957-5961 (Cell)
Laboratory Contact – Liz Bauer	(717) 556-7290	

4. APPLICABILITY OF THIS HASP

This HASP was prepared in accordance with Geosyntec's H&S Procedures for use by Geosyntec project staff and subcontractors. Subcontractors, at a minimum, shall ensure that their employees, and those of its lower tier subcontractors, comply with these procedures and other health, safety and security provisions in the Subcontract. Compliance with this HASP shall represent the minimum requirements to be met by subcontractors, who shall be responsible for examining all requirements and determining whether additional or more stringent health, safety and security provisions are appropriate for their portion of the work and implementing them accordingly. Therefore, for firms executing all or any portion of the work, this document and its contents should not be used without a thorough peer review by their health and safety managers. Prior to commencing work, such firms are responsible for reviewing and supplementing the HASP to add appropriate procedures specific to their portion of the work.

5. SITE/TASK/HAZARD DESCRIPTION

5.1 Site Background

The manufacturing portion of the SMC facility is located at 35 South West Boulevard, and is located primarily within the Borough of Newfield, Gloucester County, New Jersey. The manufacturing portion of the facility and associated support areas comprise approximately 67.5 acres. SMC also owns 19.8 acres of farmland (Farm Parcel), located approximately 2,000 feet southwest of the main facility in Vineland. The Hudson Branch, an intermittent stream, runs along the southern edge of the manufacturing portion of the facility and discharges to Burnt Mill Pond.

The manufacturing portion of the Site has a lengthy industrial history, beginning with glass manufacturing in the early 1900s. SMC first occupied the Site in 1952, operating a specialty metal plant producing chromium alloys, ferro-alloys, and other metallic products. Potassium perchlorate was used as an oxidizer in the on-Site furnace to increase temperature and enhance furnace performance. SMC's active manufacturing operations at the Site ceased in 2007. The manufacturing portion of the Site is currently used for general warehousing/leasing and administrative purposes. Current and historical use of the Farm Parcel, southwest of the manufacturing facility, is agricultural.

Previous Site investigations show concentrations of perchlorate, chromium and volatile organic compounds (VOCs), primarily trichloroethene, in groundwater. The primary contaminants in soil are chromium and vanadium, which are currently being remediated under Operable Unit 2.

5.2 Task Descriptions

Task 1: Groundwater Sampling Event

A groundwater sampling event will be performed, with groundwater being collected from 60 locations (on- and off-Site) for perchlorate and biogeochemical parameters. Groundwater samples will be collected from each of the selected monitoring wells utilizing low-flow purging and sampling methods. Further details are provided in the Task Hazard Analysis (THA) in Appendix B.

5.3 Chemical Hazards

The classes of chemicals that are known or suspected to be present that may be encountered while performing the work include the following:

- Perchlorate
- VOCs

Controls for these hazards are presented in the THAs included in Appendix B. A summary of these chemical hazards is presented in Appendix C.

5.4 Physical Hazards

The following physical hazards have been identified associated with the work to be performed and the Site conditions.

- Compressed gases
- Drum and container handling
- Electrocution
- Eye injury
- Hand/foot injury
- Heat stress
- Heavy equipment
- Knives/blades
- Lifting heavy loads
- Slips, trips, and falls
- Utility protection

Controls for these hazards are presented in the THAs included in Appendix B.

5.5 Biological Hazards

The following biological hazards have been identified associated with the work to be performed and the Site conditions.

- Allergic reaction to poisonous plants
- Biting/stinging insects
- Lyme disease and other diseases transmitted by pests
- Rats/vermin
- Snakes

Controls for these hazards are presented in the THAs included in Appendix B.

6. GENERAL SAFE WORK PRACTICES

The following general safe work practices must be adhered to while performing Site work:

- Basic personal protective equipment (PPE) shall be worn, including hard hats, safety glasses, hard-toed boots, and high-visibility vests. If conditions allow, the requirement for hard hats may be reduced with approval of the SHSO and PM. Flame resistant (FR) clothing is required while working on Site.
- Minimize contact with impacted materials. Do not place equipment on the ground. Do not sit or kneel on potentially contaminated surfaces.
- Smoking, eating, or drinking after entering the work zone and before personal decontamination is not allowed. Employees who are suspected of being under the influence of illegal drugs or alcohol will be removed from the Site. Workers taking prescribed medication that may cause drowsiness shall not operate heavy equipment and are prohibited from performing tasks where Level C or B PPE is required.
- Practice good housekeeping.
- Use of contact lenses is not allowed under certain hazardous working conditions.
- The following conditions must be observed when operating a motor vehicle:
    - Wearing seat belts is mandatory.
    - The use of headlights is mandatory during periods of rain, fog, or other adverse weather or low-light conditions.
    - A backup warning system or use of vehicle horn is mandatory when the vehicle is engaged in a backward motion.
    - Posted traffic signs and directions from flagmen must be observed.
    - Equipment and/or samples transported in vehicles must be secured from movement.
    - The use of vehicles acquired by Geosyntec by non-Geosyntec personnel is prohibited.
- In an unknown situation, always assume the worst reasonable conditions.
- Be observant of your immediate surroundings and the surroundings of others. It is a team effort to notice and warn of dangerous situations. Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Conflicting situations may arise concerning safety requirements and working conditions. These must be addressed and resolved rapidly by the SHSO and PM to relieve motivations or pressures to circumvent established safety policies.
- Unauthorized breaches of specified safety protocol are not allowed. Workers unwilling or unable to comply with established procedures will be asked to leave the Site.

7. EMERGENCY RESPONSE

This section discusses emergency response procedures and response equipment to be maintained on-Site. A table presenting a list of contacts and telephone numbers for the applicable local and off-Site emergency responders is provided in Section 3 of this HASP.

7.1 Injury and Emergency Response Procedures

In the event of an **injury** to an employee, the instructions for injury response and reporting, located in the **H&S Incident Response Procedures** instruction chart in the front of this HASP, must be implemented immediately. In the event that an **emergency** develops, the following procedures are to be implemented:

- The SHSO, or designated alternate, should be immediately notified via the on-Site communication system. The SHSO assumes control of the emergency response.
- If applicable, the SHSO must immediately notify off-Site emergency responders (e.g., fire department, hospital, police department, etc.) and must inform the response team of the nature and location of the emergency on-Site.
- If applicable, the SHSO may call for evacuation of the Site. Site workers should move to the rally point located in the western employee parking lot near the Site entrance/exit point provided on the Site Map.
- For small fires, flames should be extinguished using the appropriate type of fire extinguisher. Large fires should be handled by the local fire department.
- If a worker is injured, the procedures presented in "Instructions for Injury Response," located in the front of this HASP, must be implemented immediately.
- After an incident has stabilized, the procedures presented in "Instructions for Incident Reporting," located in the front of this HASP, must be followed.

7.2 Emergency Response Equipment

Emergency response equipment will be maintained in the work area as necessary for this project. Examples of emergency response equipment include first aid kits, fire extinguishers (Type ABC), and eyewash bottles.

8. KEY PERSONNEL AND HEALTH AND SAFETY RESPONSIBILITIES

Project personnel and their responsibilities in regard to health and safety concerns on this project are as follows:

Project Manager (PM): Seth Kellogg

- Approve this HASP and amendments, if any;
- Monitor the field logbooks for health and safety work practices employed;
- Coordinate with SHSO so that emergency response procedures are implemented;
- Check that corrective actions are implemented;
- Check and document that qualified personnel receive this plan and are aware of its provisions and potential hazards associated with Site operations, and that they are instructed in safe work practices and familiar with emergency response procedures; and
- Provide for appropriate monitoring, PPE, and decontamination materials.

Site Health and Safety Officer (SHSO): Jessica Evans

- Prepare and implement project HASP and amendments, if any, and report to the PM for action if deviations from the anticipated conditions exist and authorize the cessation of work if necessary;
- Check that Site personnel meet the training and medical requirements;
- Conduct pre-entry briefing and daily tailgate safety meetings;
- Check that monitoring equipment and PPE are operating correctly according to manufacturer's instructions and such equipment is used by on-Site personnel. Calibrate or check calibration of monitoring equipment and record results;
- Check that decontamination procedures are being implemented;
- Implement Site emergency response and follow-up procedures;
- Notify the HSC in the event an emergency occurs; and
- Perform and document weekly inspections.

Health and Safety Coordinator: Matt Mraw

- Review and audit HASP and amendments;
- Notify Director of H&S when an emergency occurs;
- Assist with the implementation of the corporate health and safety program; and
- Consult with staff on health and safety issues.

Site Workers:

- Provide verification of required health and safety training and medical surveillance prior to arriving at the Site;
- Notify supervisors of workplace accommodation requirements as the result of physical limitations or medical conditions;
- Attend pre-entry briefings and daily tailgate safety meetings;
- Immediately report accidents and/or unsafe conditions to the SHSO;
- Be familiar with and abide by the HASP; and
- Be ultimately responsible for his or her own safety.

9. WORKER TRAINING AND MEDICAL SURVEILLANCE

Personnel involved in field activities subject to OSHA HAZWOPER 29 Code of Federal Regulations (CFR) 1910.120 will be required to participate in both a health and safety training program that complies with criteria primarily set forth by the OSHA HAZWOPER in 29 CFR 1910.120(e) and a medical surveillance program covered under 29 CFR 1910.120(f), or equivalent regulations based on the jurisdiction in which the project is performed.

9.1 Pre-Assignment and Annual Refresher Training

Prior to arrival on-Site, the Geosyntec PM will be responsible for monitoring that their staff meet the requirements of pre-assignment training (40/24 hours per Procedure HS 301). In addition, personnel must be able to document dates of attendance at an annual 8-hour refresher and three days of fieldwork under a qualified supervisor. Failure to provide this documentation will prohibit entry to the active work area(s) (i.e., Exclusion Zone).

9.2 Site Supervisor Training

Consistent with OSHA 29 CFR 1910.120 (e)(4), prior to arrival on-Site, individuals designated as Site supervisors require an additional eight hours of specialized training.

9.3 Initial Site Safety Orientation and HASP Review

In addition to complying with 29 CFR 1910(e), Site personnel will attend an initial safety orientation during which the HASP and applicable THAs will be reviewed prior to initiating field activities. Site personnel will also attend an orientation conducted by the Site facility manager. This review will include the following:

- Understanding the lines of authority regarding health and safety and Site personnel roles and responsibilities;
- Information of specific hazard agents related to the Site and Site operations will be discussed, such as health hazards of Site chemicals and specific safety hazards of processes, tools, and equipment;
- Training in the proper use, maintenance, and decon protocol of PPE and Level(s) of Protection;
- Appropriate work practices and engineering controls to reduce/eliminate exposures to Site hazards will be reviewed;
- Personnel will be informed of means for normal Site and emergency communication(s);
- Air monitoring strategies will be discussed to include the frequency/types, action levels, sampling techniques, pre/post calibration techniques;
- Unique/Site specific medical surveillance requirements that need to be considered based on Site contaminants;
- Understanding Site control measures, work zones, and proper decontamination procedures for personnel/tools/vehicles, etc. to reduce the potential for both on-/off-Site contamination;

- Personnel will be trained to respond quickly and properly in the event of an emergency; and
- Personnel involved in specific hazardous activities, such as confined space entry, drum handling, sampling unknowns, etc. will receive specialized training in the appropriate techniques to employ prior to commencing these operations.

9.4 Baseline Medical Surveillance Exam

The baseline medical examination is used to identify physical capabilities and certain medical limitations that may have an impact on the candidate's ability to perform in the position and/or job activity for which he/she is being considered, as well as to establish certain baseline medical parameters. The initial test results can then be compared against future periodic or project-specific monitoring results.

9.5 Periodic/Annual/Biennial Medical Exam

The periodic medical examination is used to evaluate an employee's continued fitness for duty and to assess possible impact(s) occupational exposures may have had on their health status. The periodic examination includes an update to the medical and work history, results of previous occupational exposure assessments, and a detailed medical exam tailored to the job description.

The Medical Director from WorkCare determines the frequency of the periodic medical exams based on regulatory requirements, the position/work activities of the employee, and the level of exposure to physical, chemical, and biological agents.

9.6 Exposure/Activity/Project-Specific Medical Testing

Exposure-specific medical tests and/or evaluation of biological indices may be conducted to establish a baseline for certain project-specific parameters, to monitor the effectiveness of hazard controls, and/or to assess the impact of occupational exposures associated with a particular work activity or project. The Medical Director, in coordination with the H&S Department, will require or recommend an exposure-specific exam when deemed appropriate based on knowledge of project hazards, occurrence of employee health symptoms, or an unexpected exposure event. Requests for exposure-specific examinations will be forwarded to the H&S Department, who will process the requests in collaboration with the Medical Director. The Medical Director will determine the type and frequency of the exposure-specific medical exams for employees designated to participate based on sound medical practice, latest toxicology information, and current regulatory requirements.

9.7 Exit Exam

An exit medical examination is offered when an employee leaves the medical surveillance program, either because of termination of employment with Geosyntec or because of reassignment to a position not designated or identified to participate in the medical surveillance program. This optional exit examination may be used to assess potential changes in medical status that have occurred during the course of employees' previous work activities, and to establish a medical baseline at the time of departure.

10. MAPS AND SITE CONTROL

10.1 Routes to Hospital and Urgent Care Facility

A hospital and an urgent care facility near the Site have been identified. Maps to the hospital and urgent care are included after the Table of Contents of this HASP. Both figures also include the facility name and phone number.

10.2 Site Maps

The on-Site map and off-Site map are located in the front of this HASP. The maps are intended to provide on-Site, Farm Parcel, and off-Site area orientation and to delineate the rally point. The work zone(s) exist at each well location where groundwater will be sampled. Changes may be made to the Site maps by the SHSO based on changing Site conditions. The Site maps should be accessible in the work area.

10.3 Buddy System

The buddy system is required when work is performed in hazardous areas. The buddy system includes maintaining regular contact with one or more on-Site Geosyntec personnel, clients, and/or contractors to periodically check on the condition of Site workers such that each employee in the work group is observed by (or in verbal contact with) at least one other employee in the work group. For field visits with only one employee on-Site, the buddy system shall be implemented via periodic telephone contact with off-Site Geosyntec personnel. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

10.4 Controlled Work Zones

APPLIES TO TASK: ☒① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☐ NOT APPLICABLE

Three controlled work zones, including an Exclusion Zone, a Contaminant Reduction Zone (CRZ), and a Support Zone, are required for the task(s) indicated above. Geosyntec employees must not be allowed into the CRZ or Exclusion Zone or the Work Zone until they have received the proper personal protective equipment (PPE) and they have read, understand, and meet the requirements outlined in this HASP. The Exclusion Zone is defined as the area on-Site where contamination is suspected and tasks are to be performed. The CRZ is defined as the area where equipment and workers are to be decontaminated as they leave the Exclusion Zone. The Support Zone is defined as the command area and may serve as a staging and storage area for supplies. The location and extent of the work zones may be modified as necessary as Site investigation information becomes available. For Sites that do not require the three controlled work zones, the area(s) where work is to be performed shall be called the Work Zone.

Visitors to the Site may need to be continually escorted for safety purposes. Visitors under Geosyntec's direction need to check in with the SHSO upon visiting the Site.

For the tasks identified above, the boundaries of the Exclusion Zone, CRZ, and Support Zone, or the Work Zone, shall be marked using appropriate methods, including but not limited to warning tape, signs, traffic cones, fencing, or other appropriate means.

10.5 Site Access

Certain Sites require controlled access to the work area. Examples of access controls include sign in/sign out logs, checking in with guards, and donning identification badges. Geosyntec personnel will adhere to the Site-specific access requirements and monitor that subcontractors and other Geosyntec visitors abide by Site-specific access control requirements.

10.6 Inspections

☐ APPLICABLE ☒ NOT APPLICABLE

Based on the hazards identified for the project, periodic health and safety inspections may be performed. The H&S Inspection Checklist records should be kept on file at the project Site. The frequency for periodic inspections is:

☐ Weekly

☐ Monthly

☐ Other: _____

11. TAILGATE MEETINGS

Tailgate meetings must be held daily prior to starting work to discuss important health and safety issues concerning tasks to be performed during that shift. Non-Geosyntec Site workers should also communicate health and safety concerns associated with the tasks they will be performing. Topics discussed in the tailgate meetings must be documented.

12. STOP WORK AUTHORITY

In accordance with the Company's Procedure HS 203 – Stop Work Authority, Geosyntec personnel and subcontractor personnel have the authority and responsibility to issue a Stop Work Order if unsafe actions and/or conditions are identified. The Stop Work Authority (SWA) process involves a stop, notify, correct, and resume approach for resolving observed unsafe work actions or conditions. The person issuing the work stoppage will first notify workers engaged in or affected by the unsafe activity or condition and require that associated work be stopped. After this Stop Work Order is issued, the Geosyntec project manager and the supervisors for affected or concerned contractors will also be notified. The Geosyntec project manager will document the issuance of the Stop Work Order on the form provided in Procedure HS 203. Work will not resume until the issues and concerns of the Stop Work Order have been adequately addressed.

13. AIR MONITORING

APPLIES TO TASK: ☒① ☐② ☐③ ☐④ ☐⑤ ☐⑥ ☐⑦ ☐⑧ ☐ NOT APPLICABLE

Air monitoring will be performed to evaluate airborne chemical and/or dust exposure levels within the breathing zone of Site workers. Hazardous conditions may include concentrations that may cause acute or chronic illness, potential oxygen deficient environments, or potential explosive environments. Air monitoring may also be performed to evaluate the adequacy of engineering, administrative, and/or PPE controls. Air monitoring may be "real-time" (e.g., the instrument provides immediate results at the project), using multi-gas meters, photoionization detectors (PIDs), or colorimetric tubes. Personal monitoring may also be performed by collecting samples and forwarding to a laboratory for analysis and quantification.

The type(s) of air monitoring equipment required and associated action levels are outlined in Appendix D. Monitoring equipment must be calibrated based on the manufacturer's requirements. Calibration results and air monitoring measurements must be documented. Based on the results noted and Site activities or scope of work changes, the frequency of air monitoring may be adjusted on Site by the SHSO with the consent of the Project Manager and communication with the HSC.

14. PERSONAL PROTECTIVE EQUIPMENT

The levels of PPE required for each task are presented in

Appendix E. Required equipment and types of protective clothing materials, as well as an

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Lev per Task:	D C	D C	D C	D C	D C	D C	D C	D C

indication of the initial level of protection to be utilized, are listed. The level of protection may be upgraded or downgraded by the SHSO according to controls requirements in

Appendix E or according to action levels provided in Appendix D.

If

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Lev per Task:	D C	D C	D C	D C	D C	D C	D C	D C

respirators are worn, workers must abide by the company's Respiratory Protection Program in accordance with company's Respiratory Protection Program (HS 112).

15. DECONTAMINATION

The SHSO and Project Manager will determine the type and level of decontamination procedures for both personnel and equipment based on evaluation of specific work activities in the controlled work zones. Medical treatment will take precedence over decontamination in the event of a life threatening and/or serious injury/illness. Personnel will perform decontamination in designated and identified areas upon leaving "hot zones" where the potential exists for exposure to hazardous chemical, biological, or environmental conditions.

Decontamination of personnel in Level D (modified) will consist of proper containerization and disposal of coveralls, disposable boots, and gloves (if applicable).

Decontamination of personnel in Level C, if applicable, will consist, at a minimum, of:

- Removal and cleaning/disposal of boot covers, coveralls, and outer gloves;
- Removal, cleaning, and storage of respiratory protection;
- Washing of non-disposable PPE suspected of being contaminated using a soap solution followed by a water rinse; and
- Removal and disposal of inner gloves.

Hand tools and sampling equipment shall be decontaminated as needed by washing in decontamination basins with appropriate solutions, or, if possible, by dry decontamination. Wash solutions and PPE may require disposal at a licensed waste facility.

16. SPILL CONTAINMENT

The task(s) for this project may involve the handling of drums and/or containers that contain stored chemicals, hazardous materials, and/or wastes. The drums and/or containers may have been spilled/dislodged during Site activities due to compromised construction of the drum/container, transportation accidents, improper packaging practices, and improper handling of hazardous materials during on/off loading. Containers shall be inspected and their integrity assured prior to being moved and/or handled. If the integrity of the container is in question, the container shall be over packed or its contents transferred. Operations shall be organized and coordinated to minimize movement of such containers. Where spills, leaks, or ruptures may potentially occur, a supply of sorbents shall be located in the immediate area. Additional preventative measures include:

- UN-approved 55-gallon drums, bins, and/or Baker tanks will be inspected for visible defects upon delivery to the Site;
- UN-approved 55-gallon drums will also be inspected to ensure each drum includes a resealable lid with a small resealable sampling port near the top, or on the side of the drum and that the enclosure is not deformed and/or distorted;
- Drums will not be completely filled to allow for possible expansion of liquid and will be set on wooden pallets to facilitate transport by forklift;
- The storage area will be inspected to check for leaks weekly while the containers are being filled and immediately after a relocation to a temporary on-Site storage area; and
- Flat areas away from high-traffic work areas/zones and storm/sewer drains will be selected for temporary storage.

In the event of an unplanned release or spill of unknown or hazardous substances, the Site supervisor will designate personnel who will support the spill containment, control, and/or clean-up procedures. The team will request additional off-Site emergency response assistance if necessary based on the type of spill, volume, potential toxicity, etc.

The spill area will be isolated and restricted to only authorized personnel designated to assist with the containment, control, or clean-up activity. Authorized personnel will be trained to contain and clean spills from typical materials and quantities used at the project location. Physical barriers will be set up to warn unauthorized personnel to stay clear and evacuate the affected area. The spill, leak, or incident will be assessed by the team and characterized to determine the appropriate course(s) of action(s) to consider:

- Small spills (i.e., maximum volume of 55 gallons of a liquid or 100 pounds of a solid) may be remediated using absorbent materials by designated personnel;
- Large spills (i.e., liquid volumes greater than 55 gallons or solid weights greater than 100 pounds) and/or spills of highly toxic materials may require assistance by off-Site hazardous materials (HAZMAT) teams;

- Attempts shall be made to identify and stop the source(s) of spillage immediately while donning proper PPE (based on action levels and the air monitoring program) and performing air monitoring;
- The Site supervisor will direct spill-response operations and stay at the spill area until it has been cleaned, inspected, and cleared for re-entry; and
- The Site supervisor will prepare a spill incident and clean-up report and will communicate findings to the Project and Branch Manager and H&S Department.

17. CONFINED SPACE ENTRY

☐ APPLICABLE ☒ NOT APPLICABLE

The task(s) for this project involve confined-space entry. Workers must abide by the company's Confined Space Entry Program (Procedure HS 118).

18. GLOBALLY-HARMONIZED SYSTEM FOR HAZARD COMMUNICATION

☒ APPLICABLE ☐ NOT APPLICABLE

The following procedures must be followed for chemicals brought onto the Site by Geosyntec personnel or by subcontractors (i.e., decontamination solution, sampling preservatives, KB-1® solution, sodium permanganate, etc.) while performing the tasks of this project:

- Labels on primary chemical containers must not be defaced;
- Chemicals must be stored in appropriate storage containers;
- Secondary containers and storage cabinets must be correctly and clearly labeled;
- Chemicals incompatible with each other must not be stored together;
- Workers must receive training on the chemical hazards; and
- Safety Data Sheets (SDSs) must be added to Appendix F.

When chemicals are used on-Site, workers must abide by Geosyntec's GHS Hazard Communication Program (Procedure HS 115).

19. HASP AMENDMENTS

Over the course of this project, it is possible that the project-specific hazards and working conditions will change. This HASP may be reviewed and amended as necessary to effectively describe the changing working conditions and measures to mitigate the potential health and safety issues that may arise during the project. Amendments to the HASP should be briefly described in the following spaces provided. The full text of the amendments should be provided in Appendix A and/or additional THAs should be added to Appendix B.

AMENDMENT 1:

Date: _____ Project Manager: _____ HSC: _____

Brief Description of Amendment:

_____

_____

_____

_____

AMENDMENT 2:

Date: _____ Project Manager: _____ HSC: _____

Brief Description of Amendment:

_____

_____

_____

_____

AMENDMENT 3:

Date: _____ Project Manager: _____ HSC: _____

Brief Description of Amendment:

_____

_____

_____

_____

Appendix A: HASP Amendments

Discuss details of amendments to this HASP here. Include amendment number, date, and details of amendments.

Appendix B: Task Hazard Analyses

TASKS	
① Groundwater Sampling	⑤
②	⑥
③	⑦
④	⑧

THAs for these tasks are presented in the following pages.

Geosyntec consultants

TASK HAZARD ANALYSIS (Ver. 2, June 2015)

Geosyntec HS Procedures referenced herein are available on Geosyntec's H&S SharePoint site and should be consulted, as appropriate, per project-specific needs. This THA prepared per HS-106-Accident Prevention Program, HS-204-Task Hazard Analysis, and meets the requirements for a "Site-Specific Health and Safety Plan" per Geosyntec HS Procedures and regulations referenced herein (see Section B.14.).

PART A – SITE SAFETY PLAN

A.1. PROJECT/TASK INFORMATION

TASK:	Groundwater Sampling for Shieldalloy Metallurgical Corporation Site		
Project Name:	Shieldalloy Metallurgical Corporation OU3	**Project Number/Org:**	JR0241
Project Address:	35 West Boulevard Newfield, NJ		
Description of Task & Worksite:	Groundwater samples will be collected from sixty shallow, intermediate, and deep groundwater wells following low-flow sampling protocol using a Grundfos pump. The Site was formerly a manufacturing facility but operations have ceased and the Site is now used for general warehousing/leasing, and administrative purposes. Groundwater is anticipated to be impacted with perchlorate and volatile organic compounds. All purge water will be containerized in closed top drums.		

Geosyntec Personnel	**Name**	**Desktop Office Phone**	**Cell Phone**
Site Lead/HS Officer	Jessica Evans	(609) 493-9003	(609) 379-9685
Project Manager	Seth Kellogg	(609) 493-9018	(732) 354-8463
Project Director	John Persico	(609) 493-9008	(609) 903-6227
HS Coordinator	Matt Mraw	(609) 493-9004	(609) 462-1198
Regional HS Mngr.	Mark Malchik	(978) 206-5777	(781) 392-5440
Corp. HS Director	Dale Prokopchak	804-665-2811	(804) 349-8067
Client Contact(s):	John Hunt	(484) 582-3519	(617) 957-5961
Subcontractor(s):	☒ Not Applicable ☐ Applicable, provide contact information below:		

A.2. EMERGENCY RESPONSE

Based on analysis of worksite factors, client/regulatory requirements, availability of emergency services.

Consider all Relevant Risk Factors & Response Procedures *(fire/explosion, medical, chemicals/spills, security, Site factors, weather, communications)*.

EXPLANATORY NOTES, CLARIFICATIONS:

In case of life-threatening emergency, immediately dial 911. Once the situation is stabilized, contact the Geosyntec project manager. Evacuation of the Site will be done through the exit on West Boulevard unless a closer exit is found available.

Available Means of Jobsite Emergency Communication/Alerting	☒ Verbal ☒ Cell Phone ☐ Land Line ☐ 2-Way Radio ☐ On-Site alarm/signal system ☐ Other:	
To Summon Emergency Services Police, Fire, Ambulance	☒ **DIAL 911**, for external responders ☐ **Other**:	
Other Emergency Contacts, as needed *(such as security, spill responder, utility):*	Gas Utility: PSE&G – 1800-436-7734 or 1800-880-7734 Electrical Utility: PSE&G: 1800-436-7734 or 1800-880-7734 Unknown Utility: 811	
Nearest Emergency Medical Services	Hospital Name: Inspira Medical Center Vineland Address: 1505 W Sherman Ave Vineland, NJ 08360 Phone #: (856) 641-8000	☒ See Attached Directions
For **Non-Emergency Urgent Care**	☒ Contact WorkCare, 24/7 at: 888-449-7787 ☒ Other: Inspira Urgent Care (856) 507-8548 1297 W Landis Ave, Vineland, NJ 08360	☒ See Attached Directions
Jobsite **Evacuation** Procedure, Rally Point, Place of refuge:	In case of evacuation, on-Site workers must meet at Site entrance on West Boulevard. Exit must be kept open for emergency vehicles.	
Special Emergency Equipment/Procedures	No special procedures	

IMPORTANT: After initial emergency response actions and incident stabilization, contact appropriate project personnel listed in Part A.1.

A.3. SUMMARY OF WORK STEPS, HAZARDS, CONTROLS

Based on **PART B, "HAZARD ANALYSIS,"** and worksite/client/project factors.

Task 1 – Travel to Site

Geosyntec travels to the Site and arrives at 35 West Boulevard.

Task 2- Check-in and initial setup of work zone

Geosyntec conducts tailgate safety meeting and sections off an area for calibration/staging.

Task 3 Equipment Preparation

Geosyntec calibrates the PID using isobutylene span cal gas. Geosyntec calibrates the YSI sonde using calibration standard solutions. Spent calibration fluid and spring water is contained in a 5-gallon bucket and disposed of with decon fluid and purge water (See Task 6). An equipment blank is taken.

Task 4 – Initial Water Level Measurements

At each of the monitoring wells, Geosyntec opens the manhole/stickup with hand tools and collects a water level measurement using a water level meter. The depth to bottom is also measured. The water level meter is deconned between each well (See Task 7)

Task 5 – Purge and sample monitoring wells

The Grundfos pump is prepared for groundwater purging and sampling. Tubing is cut to size and hooked up to the Grundfos pump. The Grundfos pump control box is set up, and the pump is lowered to the sampling interval in the well. At each well, groundwater is extracted through the Grundfos pump and purged into a 5-gallon bucket staged at the monitoring well after running through the flow-through cell of the YSI sonde. Once water quality parameters are stabilized, the flow-through cell is removed and groundwater samples are collected for analyses.

Task 6 – Purge water containerization

Purge water in 5-gallon buckets is transferred to and containerized in drums. The drums are sealed, labelled with a pending analysis drum label and stored on Site until pickup.

Task 7 – Equipment Decontamination

Equipment exposed to groundwater is deconned with Alconox solution and distilled water. Decon fluid is drummed with purge water.

Task 8 – Sample Transport Prep

Groundwater samples are packed in coolers on ice and prepared for either shipment or pick up by the laboratory. The chain of custody is completed.

Task 9 –Demoblization

Manhole covers are replaced, stick-up risers are closed and locked, and cones are removed. Calibrated equipment is cal-checked. All equipment is packed into the field vehicle. Geosyntec notifies project manager that the work was completed and leaves Site.

Task 10 – Travel off Site

Geosyntec travels off Site.

Safety "Key Words or Phrases"

- Driving safety (Task 1, 10)
- Pinch points (Task 2-9)
- Air monitoring (Task 2-9)
- Eye protection (Task 2-9)
- Foot protection (Task 2-9)
- Hand protection (Tasks 2-9)
- Heavy lifting (Task 2, 3, 5, 6, 7, 8, 9)
- Electrical safety (Task 3, 5, 9)
- Compressed gases (Task 3, 9)
- Exposure to contaminants (Task 4, 5, 6, 7, 8, 9)
- Exposure to corrosives (Task 5, 7, 8)

For Hazard Control Measures, See Parts B and C, below.

A.4. H&S EQUIPMENT LIST

List worksite equipment for worker protection; provide details in Explanatory Notes, Clarifications.

EXPLANATORY NOTES, CLARIFICATIONS: High-vis vest, hard-toed boots, and safety glasses must be worn at all times by on-Site personnel. A hard hat must be worn at all times while on Site, but is not needed at the off-Site Farm Parcel or other off-Site locations. Nitrile gloves must be worn when handling groundwater, decon fluids, and equipment exposed to groundwater. Geosyntec will have a first aid kit, emergency eyewash, and fire extinguisher on hand. Sun screen and an easy-up tent will be used when weather conditions warrant their use. The sampling crew will mark out the monitoring wells with traffic control devices such as cones or similar so that enough room is provided for the sampling crew to operate. A PID will be used to monitor air quality when monitoring wells are opened. Used PPE will be disposed by Geosyntec.

☒	**ROUTINE PPE**	☒ Standard work clothes appropriate for task ☒ Hard-toed boots/shoes ☒ Hardhat ☒ Safety glasses	☒ Work gloves appropriate for task ☐ Noise/hearing protection ☒ High-visibility/reflective vest ☐ Ice creepers (boot attachments)
		☒ Basic PPE for protection from low-hazard chemical contact & dust (nitrile gloves, Tyvek suit, dust mask, boot covers).	
☒	**ROUTINE H&S EQUIPMENT/GEAR**	☒ First Aid Kit ☒ Fire extinguisher ☒ Emergency eyewash bottle(s) ☒ Insect control (repellant, wasp spray, other) ☐ Caution tape	☒ Sun protection (sunscreen, shade canopy, other) ☒ Project-supplied drinking water and/or hygiene facilities ☒ Poison ivy skin wash (Technu or similar) ☒ Vehicle emergency kit (flares, lights, reflective device) ☒ Traffic control warning devices (cones, or similar)
		☐ Other:	

☐	**NON-ROUTINE PERSONAL PROTECTIVE EQUIPMENT (PPE)** (Indicate specific types of PPE in Explanatory Notes, Clarifications)	☐ Goggles and/or face shield ☐ Chemical protective gloves ☐ Coveralls (Tyvek, or other) ☐ Outer boots, boot covers	☐ Disposable n-95 dust mask ☐ Half-face respirator (APR), cartridges ☐ Full-face respirator (APR), cartridges ☐ Personal flotation device	☐ Fire retardant clothing ☐ Arc Flash Protection ☐ Electrical-Hazard-rated boots, gloves ☐ Personal fall apparatus
		☐ Other:		
☐	**SPECIAL HAZARD CONTROLS**	☐ Portable GFCI	☐ Lockout/tagout equipment	☐ Ventilation equipment (fan, blower)
		☐ Eyewash - 15 min. flow	☐ Emergency deluge shower	☐ Air horn, alarm
		☐ Other:		
☒	**DECON, PPE DISPOSAL**	☒ Receptacle for disposable PPE	☐ Hand washing provisions	☐ Decon solution, related supplies
		☐ Other:		
☒	**AIR MONITORING EQUIPMENT, OTHER EQUIPMENT FOR WORKER EXPOSURE TESTING**	List equipment/devices to be brought to worksite; Use in accordance with procedures in Part C: PID		

PART B – HAZARD ANALYSIS and CONTROLS *Complete Section B.1., then subsequent sections as applicable to the task(s).*

B.1. ROUTINE HAZARD PREPAREDNESS **This section required for all tasks.**

Explanatory Notes, Clarifications: The monitoring wells are spread out across 67 acres. Caution will be exercised driving to wells, and personnel will maintain awareness of their surroundings. Insect repellant spray and/or long sleeves are recommended as biting insects and poisonous plants may be encountered. Insect repellant spray will be made available. High-vis vest, hard-toed boots, and safety glasses must be worn at all times. Nitrile gloves must be worn when handling groundwater, decon fluids, and equipment exposed to groundwater. Good housekeeping must be maintained in the work zone to minimize trip hazards. Proper lifting techniques must be followed when moving sampling equipment and coolers. Anything greater than 50 lbs requires a two-person lift. Cut-resistant protective gloves must be worn when cutting plastic sheeting and tubing. Tubing cutters should be used when cutting tubing. Protective gloves should be worn when lifting heavy equipment, opening or closing drum lids, and opening manhole covers. Sampling crews must adhere to the 30/30 rule for lightning and must seek shelter in a field vehicle. Crews must monitor for heat stress and drink plenty of fluids throughout the course of the day. Seek shade when needed and set up a canopy over the monitoring well if warranted due to high temperatures. If work is to be performed alone, the sampler must check in with the project manager at the start of the day, mid-day, and at the end of the day.

General Safety, Wellness, Preparedness – **Delineate Site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **General premises** hazards - housekeeping, rough terrain, trip hazards, steep slope, remote location.
☒ **Weather/climate-related hazards** – heat stress/cold stress measures, sun screen, severe weather shelter/refuge, "30/30 rule" for lightning
☒ **Plant/Insect/Animal Hazards** - Precautions: poison ivy wash; insect repellant; check for ticks; hornet nest spray; animal precautions.
☒ **Worksite traffic hazards** – Implement measures to protect personnel (high visibility/reflective clothing, on-person lighting, traffic control measures).
☐ **Illumination hazards/night work** - Illuminate work areas and/or access routes, use reflective/hi-visibility clothing or on-person lighting, as appropriate.
☒ **Lifting, manual material handling** – use proper lifting procedures, seek help for >50 lbs.

Geosyntec Procedures: *HS-124-Heat Stress, HS-125-Cold Stress, HS-127-Ticks, HS-208-Housekeeping, HS-210-Walking and Working Surfaces, HS-401-Back Injury Prevention, HS 517 Traffic Safety*

Routine Personal Protection – **Delineate Site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☐ **Head protection from overhead hazards** - Wear hardhat or "bump cap" as appropriate for hazard.
☒ **Hand protection** - Wear protective work gloves appropriate for the hazard and work tasks.
☒ **Eye protection** - Wear safety glasses (with side shield or wrap around, either clear or shaded for sun protection), or other appropriate eye protection.
☒ **Foot protection, rough terrain** - Wear work boots/shoes with hard toes, ankle support, puncture resistance, traction, as appropriate for conditions.
☐ **Hearing protection** – use earplugs, earmuffs (or both) as appropriate for conditions; at a minimum where noise levels exceed 85dBA.
☐ **Dust, unsanitary conditions** – For general protection against minimal non-specific hazards, use protective clothing and/or disposable dust mask, as needed.

Geosyntec Procedures: *HS-109-Hearing Conservation, HS 112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-207-Working Alone, HS-105-Driver and Vehicle Safety*

Tools, Equipment, Machinery – **Delineate Site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **Manual hand tools -** proper tool for the job, maintain in good condition, use vise/clamp to hold work piece, proper follow through, stay clear of "line of fire."
☒ **Knives, cutting tools -** Utility/folding/collapsible knives and fixed open-bladed knives/cutting tools are *not* permitted, unless specifically authorized. Cutting tools with automatically-retracting blades, or with enclosed/guarded blades are permitted. See HS-502-*Manual Hand Tools* for additional Information.
☐ ***Working near*** **powered tools/equipment/machinery** – safe distance, heed warning signs, stay out of "line of fire," use PPE (for eye/hearing/dust protection).
☐ ***Operation/use of*** **powered tools/equipment/machinery – See Section B.5.**

HS-502-Manual Hand Tools

Security– **Delineate Site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☐ **High crime, urban** – Use appropriate measures for personal security (such as buddy system, security service, work scheduling, other measures)
☒ **Working alone** - Establish "check in" procedure with supervisor/project manager.

Geosyntec Procedures: *HS-207-Working Alone*

Routine Driving Hazards – **Delineate Site-specific HS aspects, as appropriate, in "Explanatory Notes, Clarifications," above.**

☒ **Routine work travel** - Use routine safe/defensive driving practices (seat belts, safe speeds, eyes ahead, no tailgating, limit distractions, safe cell phone use, no texting, clear windows, account for weather/road conditions, adequate sleep, other measures as appropriate).

☒ **Unfamiliar location** - Plan travel route before driving (assemble maps, enter destination in GPS).

☒ **Long Distance or During Sleep Hours** – Minimize fatigue: rest breaks, light snacks (avoid heavy meals), stay hydrated, fresh air, no loud music, clean windshield.

☒ **Unfamiliar vehicle** – Become familiar with vehicle operational controls and handling characteristics before operating vehicle.

Geosyntec Procedures: *HS-105-Driver and Vehicle Safety*

B.2. SPECIAL DRIVING/TRAFFIC/TRANSPORTATION HAZARDS	☐Applicable	☒ Not Applicable, Not Anticipated
B.3. WATER/BOATING HAZARDS	☐ Applicable	☒ Not Applicable or Not Anticipated
B.4. FALL HAZARDS	☐ Applicable	☒ Not Applicable, Not Anticipated
B.5. POWERED TOOLS, EQUIPMENT, MACHINERY	☒ Applicable	☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS: A generator will be used to provide electricity to run the Grundfos pumps.

☐	**POWERED HAND TOOLS** ☐ Battery-operated ☐ Electric-powered, 120v/240v ☐ Fuel-powered ☐ Pneumatic ☐ Powder-actuated Hazards: Eye/hand/body injury, fuel-related hazards, Inhalation hazards, noise, sparks, heat, fire hazard, electrical hazards	☐ For all power tools: • Inspect tools to ensure safe operating condition before each use. • Use tool in accordance with manufacturer's specifications. • Ensure guards are in place and no hazardous equipment modifications. • Use PPE or other safety practices, as appropriate, for eye/hearing/hand/head/body protection. • Provide training or verify operator competency for use of power tool. • Stay clear of hazard zone, "line of fire," when working near where power tools are used. • For spark/heat generating tool, control fire hazards, segregate combustible/flammable materials. • Use vise/clamp/work bench or other appropriate means to hold/secure the work piece. ☐ Use respirators, ventilation, wet methods, other appropriate means to control inhalation hazard. ☐ See fuel-safety practices in Section B.13., "Commercial Chemical Products." ☐ For electrical hazards, see Section B.8., "Electrical Hazards". ***Geosyntec Procedure(s):*** *HS-109-Hearing Conservation, HS-113-Personal Protective Equipment, HS-121-Electrical Safety, HS-503-Powered Hand Tools, Others as applicable*
☐	**OPERATION OF EQUIPMENT/MACHINERY** ☐ Point-of-operation hazards ☐ Pinch points, moving parts ☐ 'Struck-by,' 'caught between' ☐ Hot surfaces, heat ☐ Extension cords, flexible wire ☐ Fuel related (gas or liquid) ☐ Hydraulic pressure ☐ Pneumatic pressure ☐ Kinetic, stored energy ☐ Noise ☐ Emissions, discharge gases ☐ Working at heights, falls ☐ Lifting, repetitive motion ☐ Illumination ☐ Electrical	☐ General safety requirements for equipment, machinery: • Arrange worksite for safe access to equipment/machinery. • Use equipment/machinery in accordance with manufacturer's use and safety instructions. • Ensure point-of-operation, mechanical power transmission, other moving parts are guarded with protective devices; do not override interlocks, guards, protective devices. • Secure long hair/loose clothing/hanging jewelry near moving/rotating parts. • Heed warning signs/labels, keep safe distance; avoid locations of "struck by" and "caught between" hazards. • Implement lockout/tagout for repairs/adjustments/tooling changes. ☐ Use safe lifting practices for movement of heavy portable equipment ☐ Implement safe work practices for compressed air, pressurized systems (pneumatic/hydraulic), stored energy. ☐ For climbing/fall hazards associated with large equipment, see Section B.4., "Fall Hazards." ☐ For electrical hazards, see Section B.8., "Electrical Hazards." ☐ Operate fuel-powered equipment in well ventilated location. ☐ Use safe practices for fuels, see Section B.13., "Commercial Chemical Products." ***Geosyntec Procedure(s):*** *HS-109-Hearing Conservation, HS-113-Personal Protective Equipment, HS-119-Lockout/Tagout, HS-121-Electrical Safety, HS-503-Powered Hand Tools, Others as applicable*
☐	**LOCKOUT/TAGOUT OF HAZARDOUS ENERGY**	☐ Implement control-of-hazardous-energy practices (lockout/tagout), provide lockout/tagout locks and devices, training workers, designate "authorized" personnel, notify "affected" personnel. ***Geosyntec Procedure(s):*** *HS-119-Lockout Tagout*
☐	**WELDING, CUTTING, HOT WORK (GAS OR ARC)** UV/IR light-eye/skin burns, hot-work hazards, toxic welding fumes, compressed gases, electrical shock	☐ General safe work practices: • Hot work permit system to be implemented. • Operator properly protected (eye protection, clothing, apron, etc.). • Fire hazard controls (watcher, fire extinguisher, water, isolate combustibles). • Protect nearby personnel from hazardous UV, IR light (shielding, curtain). ☐ For gas welding/cutting, use gas cylinder safe practices (secured, upright, caps on when not in use, prevent Damage; never secure gas cylinders to metal bench used for arc welding). ☐ For arc welding, follow electrical safe work practices. See Section B.8., "Electrical Hazards." ☐ See Section B.13., "Commercial Chemical Products," for hazards of welding rods (toxic metals), welding gases. ***Geosyntec Procedure(s):*** *HS-511-Welding, Cutting and Other Hot Work*
☐	**COMPRESSED AIR, COMPRESSOR** (for compressed gases, see Section B.13., "Compressed Gases")	☐ Never direct nozzle toward body; do not use compressed air for cleaning clothes. ☐ If compressed air is used for cleaning, restrict pressure to 30 psi or below, equip nozzle with chip guard. ☐ Use eye protection. ☐ Ensure air tank, hoses, fittings are in good repair using factory fittings.

☒	**PORTABLE GENERATOR** Hazards: Electrical shock, carbon monoxide in exhaust, fuel-related fire, injury from mechanical hazards, lifting	☒ Follow general safety practices for Operation of Equipment/Machinery (above), and as follows: • Use in accordance with manufacturer's instructions. • Keep generator and work area dry. • Never use indoors, or near building air intake vents due to carbon monoxide hazard. • Provide for ventilation and/or air monitoring where hazardous accumulation of exhaust emissions is possible. • Use hearing protection in close proximity to operating generator, as needed. • Use power cords/extension cords specified by instructions. • Use ground-fault circuit interrupters (GFCIs) in accordance with manufacturer's instructions. • See Section B.8., "Electrical Hazards." • Shut down equipment before refueling. See safe practices for flammable/combustible liquids in Section B.13., "Commercial Chemical Products." ***Geosyntec Procedures:*** *HS-109-Hearing Conservation, HS-111-Air Monitoring, HS-115-Hazard Communication (for fuel), HS-121-Electrical Safety, Others as applicable*
☐	**PORTABLE HEATERS** **(electric or fuel powered)** Hazards: Electric-powered: Electrical shock, fires from hot surfaces. Fuel powered: Carbon monoxide in exhaust, fires from hot surfaces, fuel-related fires	☐ Follow general safety practices for Operation of Equipment/Machinery (above), and as follows: • Keep heater dry, and locate heater on level surface away from high traffic areas. • Never use fuel-powered heaters indoors, or near air intake vents, due to carbon monoxide hazard. • Provide for ventilation and/or air monitoring where hazardous accumulation of exhaust emissions is possible. • Keep combustible materials at least 3 feet from hot surfaces. • Do not use an extension cord or power strip to power an electric heater. • For electric heaters, See Section B.8., "Electrical Hazards." • Shut down fuel-powered equipment before refueling. See safe practices for flammable/combustible liquids and/or compressed gases in Section B.13., "Commercial Chemical Products." ***Geosyntec Procedures:*** *HS-111-Air Monitoring, HS-115-Hazard Communication (for fuel, HS-121-Electrical Safety, Others as applicable*

B.6. DRILLING ☐ Applicable ☒ Not Applicable, Not Anticipated

B.7. CONSTRUCTION, HEAVY EQUIPMENT, LIFT EQUIPMENT ☐ Applicable ☒ Not Applicable, Not Anticipated

B.8. ELECTRICAL HAZARDS ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

Sampling crews must be cognizant of electrical hazards associated with extension cords and wet locations and use precautions accordingly.

☒	**BASIC ELECTRICAL HAZARDS TO SKILLED NON ELECTRICAL WORKERS** Equipment/tool use/operation, use of extension cords, working near electrical equipment. Hazards: Electrical shock, secondary hazards (falls, other injuries).	☒ Follow safe work practices: • Control water-related/wet-location hazards in a manner appropriate for the job tasks/equipment/tool. • Never touch electrical equipment if you are wet, or standing in water or on wet surfaces. • Use extension cords/power cords properly, prevent damage, take out of service if damaged. • Inspect tool/equipment/extension cords/power cords/welding cables before each use; do not use if damaged. • Use GFCI-protected outlet or portable GFCI in wet locations, outdoors, basements, concrete floors. • Ensure live parts are guarded, enclosures secure. • Enclosures, circuits properly labeled. ***Geosyntec Procedure(s):*** *HS-121-Electrical Safety*
☐	**HANDS-ON ELECTRICAL WORK BY ELECTRICAL WORKER/TECHNICIAN:** ☐ Voltage < 50 v ☐ Voltage 50-600v ☐ Voltage > 600v ☐ AC ☐ DC ☐ 3-phase ☐ Battery and/or solar power ☐ Capacitor/transformer	☐ Implement electrical safe work practices pertaining to: • Worker training/qualification (Level 1, Level 2, Level 3) • General electrical safe work practices, grounding, use of GFCIs • Safe work practices during diagnostics/troubleshooting, maintenance, repair • Safe design features for electrical equipment • Arc flash protection ***Geosyntec Procedure(s):*** *HS-121-Electrical Safety, HS-129-High Voltage Electricity Safety*
☐	**LOCKOUT/TAGOUT OF ELECTRICAL ENERGY**	☐ Implement control-of-hazardous-energy practices (lockout/tagout), provide lockout/tagout locks and devices, training workers, designate "authorized" personnel, notify "affected" personnel. ***Geosyntec Procedure(s):*** *HS-119-Lockout Tagout, HS-121-Electrical Safety*
☐	**IMPORTANT!** This work may/will include close proximity to electric utility lines.	☐ Follow safe work practices per Section B.9., "Utility Related Hazards"

B.9. UTILITY RELATED HAZARDS ☐ Applicable ☒ Not Applicable, Not Anticipated

B.10. CONFINED SPACE ENTRY, HAZARDOUS ENCLOSED SPACES ☐ Applicable ☒ Not Applicable, Not Anticipated

B.11. STORAGE OF BULK MATERIALS ☐ Applicable ☒ Not Applicable, Not Anticipated

B.12. INFECTIOUS / ALLERGENIC BIOHAZARDS ☐ Applicable ☒ Not Applicable, Not Anticipated

B.13. COMMERCIAL CHEMICAL PRODUCTS ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

Isobutylene will be used to calibrate the PID. These gas cylinders will be used in a well ventilated area. The cylinders will be emptied outdoors after use. Geosyntec personnel will not travel with unemptied cylinders in the vehicle. Small amounts of strong acids including HCl and HNO3 will be used as preservatives in bottle ware for analyses. Care will be taken by Geosyntec to avoid overfilling bottles and contacting acid with skin or clothing, and an eyewash bottle should be available

at each sampling location (where acid-preserved containers are opened and closed) in case of eye contact with acid preservative. An eyewash bottle should be available when deconning as well.

☒	**PRODUCTS REGULATED BY HAZARD COMMUNICATION STANDARD**	☒ Safety Data Sheets available, either on Site or readily available within same work shift, containers labelled properly, workers trained/oriented on hazards ☐ For subcontractor use of chemical products, coordinate/discuss during safety meetings. ☐ Conduct air monitoring, as appropriate (see Part C, "Air Monitoring, Worker Exposure Monitoring").
☒	**COMPRESSED GAS (flammable or nonflammable)**	☐ Secure cylinders upright, caps on when not in use, handle with care, prevent damage. ☐ Propane cylinders not in use must be stored outdoors in cage or similar secure enclosure. ☐ Ensure acetylene cylinders NOT secured to steel arc welding bench. ☒ Store/use in a manner to prevent asphyxiation hazard. ☐ Segregate oxygen and fuel gases by distance (20') or barrier. ☐ Control ignition sources. ☐ "No smoking" signage at cylinder storage area for flammable gases. ☐ Use/store in a manner to control inhalation exposure hazards, PPE, air monitoring.
☐	**FLAMMABLE/COMBUSTIBLE LIQUIDS**	☐ Proper storage (flam. storage cabinets, other storage precautions). ☐ Use proper fuel safety can (metal fuel can preferred). ☐ Control ignition sources. ☐ Grounding and bonding where appropriate.
☒	**ACIDS, CAUSTICS, OTHER CORROSIVES**	☒ Handle with care, use appropriate eye/face/skin protection. ☒ Eyewash, deluge shower, drench hose, hand washing (with water), as appropriate.
☒	**TOXIC**	☒ For toxic substances, use/store in a manner to control exposure hazards (inhalation, ingestion, skin contact, skin absorption); use PPE as appropriate, conduct air monitoring as appropriate.
☒	**EMISSIONS FROM FUEL COMBUSTION, INDUSTRIAL PROCESSES** ☒ Gasoline ☐ Diesel ☐ Propane/Natural Gas ☐ Welding/cutting/hot work ☐ Vehicle/equipment exhaust ☐ Other	☒ Position outdoor personnel upwind of exhaust source. ☐ Use blowers, fans to provide fresh air to work area and dissipate atmospheric hazards. ☐ Use respiratory protection for high levels of smoke, exhaust particulates, soot. ☐ Conduct air monitoring as appropriate (see Part C, "Air Monitoring").
☐	**OTHER HAZARDS**	☐ Describe other hazardous substances and safety measures under "Explanatory Notes, Clarifications," above.
☐	**CHEMICAL/HAZMAT STORAGE** Check this when jobsite requirements include special provisions for chemical storage.	☐ Chemical storage cabinet, cage, storage room, or similar. ☐ Ensure incompatible chemicals are segregated. ☐ Provide secondary containment. ☐ Locate special safety equipment near chemical storage

Geosyntec Procedures: *HS-115-Hazard Communication, HS-111-Air Monitoring, HS-112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-114-Safety Training Programs, Others as applicable*

B.14. SITE CONTAMINANTS, CHEMICAL WASTES ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:

Potassium perchlorate and volatile organic compounds are present in Site groundwater due to past use in manufacturing processes on Site.

CHECK ALL THAT APPLY. Provide explanatory notes above.

☒ Soil/groundwater contaminants (historical release)	☐ Oxygen deficiency	☐ Corrosive, acids/caustics, strong irritants
☐ Recent release, known high concentrations	☒ Chlorinated volatile organic compounds (VOCs)	☐ Sulfides, hydrogen sulfide (H_2S)
☐ Former chemical disposal Site, landfill	☐ BTEX, petroleum derived VOCs	☐ Cyanides, hydrogen cyanide (HCN)
☐ Urban fill, residual contaminants	☐ Fuel oils, petroleum, waste oil, lubricants	☐ Asbestos
☐ Containerized waste (drums, process equipment)	☐ Metals, metal compounds, metal dusts	☐ Lead paint
☐ Buried drums (known or potential)	☐ Elemental mercury	☐ Pesticides, herbicides, fungicides
☐ Large containers, potential for spills	☐ Polyaromatic hydrocarbons (PAHs)	☐ Sensitizers
☐ Contaminated building surfaces	☐ Polychlorinated biphenyls (PCBs)	☐ Radioactive contaminants
☐ Unexploded ordnance	☐ Potential for flammable vapors	☐ Other (see Explanatory Notes, above)
☐ Explosive dust	☐ Potential for flammable gas (methane)	

☐ **FOR WORK CONSISTING OF CLEANUP OPERATIONS, CORRECTIVE ACTIONS, PRELIMINARY INVESTIGATIONS at an "UNCONTROLLED HAZ. WASTE SITE" (per HAZWOPER, 29 CFR 1910.120), implement the following as applicable to the work:**

- Implement Site control plan via Exclusion Zone(s), Contaminant Reduction Zone(s) and Support Zone (aka EZ, CRZ, SZ)
- Workers to be aware of and trained on hazards per OSHA Hazard Communication Standard.
- Include Site map/figure depicting work locations and other relevant Site-specific information.
- Site workers in EZ or CRZ to have OSHA 40-hour training, current 8-hour refresher, 3 days supervised field experience.
- Site supervisor(s) required to have 8-hr. Supervisor training.
- Site workers in EZ or CRZ to participate in Medical Monitoring program, as applicable.

	- Implement Site-specific procedures for worker protection via engineering controls, work practices, personal protective equipment (PPE), air monitoring, decontamination procedures, spill containment, emergency preparedness and response. - Conduct air monitoring, as appropriate (see Part C, "Air Monitoring, Worker Exposure Monitoring"). **IMPORTANT:** Provide supplemental information to sufficiently detail Site-specific procedures for the above elements, as appropriate for the work. ***Geosyntec Procedures:*** *HS-301-HAZWOPER, HS-108-Medical Monitoring Surveillance, HS-111-Air Monitoring, HS-112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-114-Safety Training Programs, HS-115-Hazard Communication, HS-405-Drum Sampling, Others as applicable*	
☒	**FOR SITE WITH CHEMICAL CONTAMINANTS OR WASTE BUT NOT REGULATED BY HAZWOPER** - Workers to be knowledgeable/aware of chemical hazards thru safety training/orientation and availability of hazard information - Implement controls to minimize worker exposure through engineering controls, work practices, PPE, as appropriate. - Conduct air monitoring/sampling to monitor/evaluate worker exposure, as applicable. ***Geosyntec Procedures:*** *HS-111-Air Monitoring, HS-112-Respiratory Protection, HS-113-Personal Protective Equipment, HS-114-Safety Training Programs, HS-115-Hazard Communication, Others as applicable*	
☐	**OFF-SITE MIGRATION OF CONTAMINANTS**	☐ Implement controls to minimize hazard migration (dust suppression, covers, foam, etc.) ☐ Community/perimeter air monitoring to be conducted per perimeter air monitoring plan.
☐	**SPILL CONTAINMENT, CONTAINERS**	☐ Describe above any Site-specific procedures for spill containment, container handling, as applicable. ***Geosyntec Procedures****: HS-406-Unknown Hazardous Waste Drum Handling*

B.15. RADIATION HAZARDS (Other than Sunlight) ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS: One of the materials used and stored during past Shieldalloy operations contained radioactive material. Shieldalloy is currently decommissioning this material. All of the material has been moved to fenced off exclusion zones on-Site. It is not anticipated that Geosyntec personnel will need to come into contact with this material. Geosyntec personnel should not enter the fenced off exclusion zones.

☒	**IONIZING RADIATION**	Describe hazards & safety measures above in Explanatory Notes, Clarifications. Conduct exposure monitoring, as appropriate (see Part C, "Air Monitoring, Worker Exposure Monitoring"). ***Geosyntec Procedures:*** *HS-126-Radiation Safety Program, HS-128-Ionizing and Non-Ionizing Radiation*
☐	**NON-IONIZING RADIATION**	Describe hazards & safety measures above in Explanatory Notes, Clarifications. Conduct exposure monitoring, as appropriate (see Part C, "Air Monitoring, Worker Exposure Monitoring"). ***Geosyntec Procedures:*** *HS-128-Ionizing and Non-IonizingRadiation*

B.16. HAZMAT/DANGEROUS GOODS SHIPPING/TRANSPORTATION ☐ Applicable ☒ Not Applicable, Not Anticipated

PART C – AIR MONITORING, WORKER EXPOSURE MONITORING

C.1. AIR MONITORING (Direct-Reading Instruments) ☒ Applicable ☐ Not Applicable, Not Anticipated

EXPLANATORY NOTES, CLARIFICATIONS:
Air monitoring will be performed with a PID when opening monitoring wells. If levels higher than 1 ppm are detected, then the sampling crew will stand back from the well with the monitoring well left open to allow for VOC concentrations to dissipate. Elevated PID readings are not anticipated for this Site.

☒	**AIR-TESTING PARAMETERS**	☒ VOCs, GASES ☒ PID, Lamp energy: 10.6 eV ☐ FID ☐ Carbon monoxide ☐ Hydrogen sulfide ☐ Oxygen (O_2)		☐ Flammable gas (LEL) ☐ Particulate (dust) ☒ Calibration kit for each parameter ☐ Other:
☐	**ACTION LEVELS FOR O2/LEL**	☐ Oxygen	≤19.5% - ventilate to raise O_2 to acceptable levels, or use Level B. ≥23.0% - ventilate to lower O_2 to acceptable levels, or use Level B and control fire hazards & ignition sources.	
		☐ LEL	Confirm at least 12% oxygen is present to ensure accuracy of LEL readings. At <10% LEL - Continue working, continue to monitor LEL levels At ≥10% LEL- Immediately withdraw from area. Resume work ONLY after LEL readings reduced to <10%.	

☒	**ACTION LEVELS FOR TOXICS** (sustained breathing zone concentrations)	**Parameters**	**Level D, Modified D***	**Use levels C or B*, as indicated below, OR take action to reduce breathing zone level to concentration acceptable for Level D*.**
		☒ VOCs	< 1.0 ppm	___ ppm to ___ ppm: Level C (air purifying respirator) > ___ ppm: Level B (air-supplied respirator)
		☐ Carbon Monoxide	< 35 ppm	≥35 ppm - Level B (air-supplied respirator)
		☐ Hydrogen Sulfide	< 10 ppm	≥10 ppm - Level B (air-supplied respirator)
		☐ Total Dust	< ___ mg/m^3	> ___ mg/m^3 - Level C (air-purifying respirator)
		☐		
		☐		

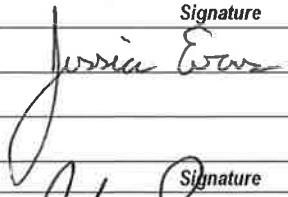
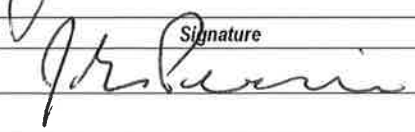
*** Levels of Protection:**
Level D (standard work clothes, basic personal protective wear, no chemical protective clothing, no respiratory protection)
Modified Level D (chemical protective clothing in addition to standard work clothes, no respiratory protection)
Level C (air purifying respirator or dust mask, in addition to chemical protective clothing)
Level B or A (air supplied respirator, chemical protective suit; fully-encapsulating suit for Level A)

Geosyntec Procedures: *HS-111-Air Monitoring*

C.2. OTHER WORKER EXPOSURE MONITORING ☐ Applicable ☒ Not Applicable, Not Anticipated

PART D – APPROVALS, ACKNOWLEDGEMENTS

D.1. THA PREPARATION, REVIEW/APPROVAL SIGNATURES - THA typically prepared by project staff, reviewed/approved by Project Manager, Supervisor, qualified/knowledgeable designee, with support of HS personnel as deemed appropriate by the Project Manager.

	Printed Name	*Signature*	*Date*
THA PREPARED BY: (minimum one person)	Jessica Evans		April 15, 2019
	Printed Name	*Signature*	*Date*
THA REVIEWED/ APPROVED BY: (minimum one person)	John Persico		April 15, 2019
	Seth Kellogg		

D.2. FIELD CREW ACKNOWLEDGEMENTS

GEOSYNTEC FIELD CREW

Please sign below to acknowledge you reviewed and understand this THA, participated in project safety briefing and had an opportunity to ask questions about the information herein.

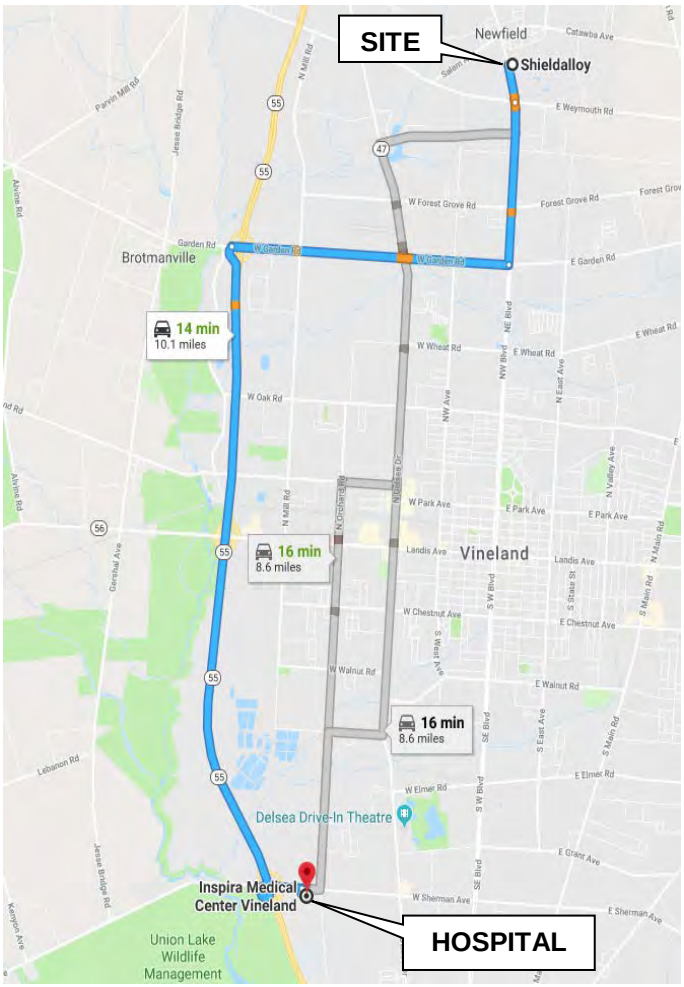
Printed Name	Signature	Employee No.	Date

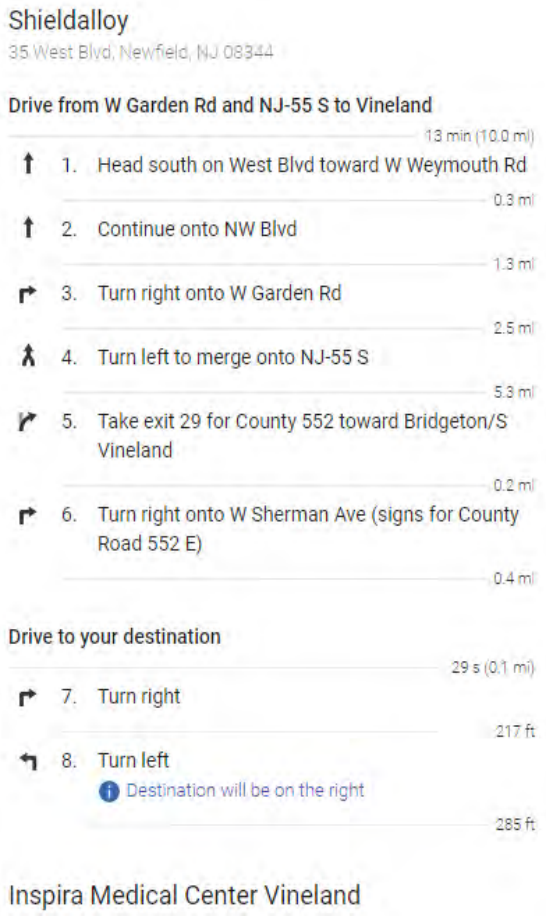
SUBCONTRACTOR'S FIELD CREW

Please sign below to acknowledge that this THA was made available to you, and you had an opportunity to ask questions about the information herein.

Printed Name	Signature	Company Name	Date

ROUTE TO HOSPITAL





Shieldalloy
35 West Blvd, Newfield, NJ 08344

Drive from W Garden Rd and NJ-55 S to Vineland

13 min (10.0 mi)

1. Head south on West Blvd toward W Weymouth Rd — 0.3 mi
2. Continue onto NW Blvd — 1.3 mi
3. Turn right onto W Garden Rd — 2.5 mi
4. Turn left to merge onto NJ-55 S — 5.3 mi
5. Take exit 29 for County 552 toward Bridgeton/S Vineland — 0.2 mi
6. Turn right onto W Sherman Ave (signs for County Road 552 E) — 0.4 mi

Drive to your destination

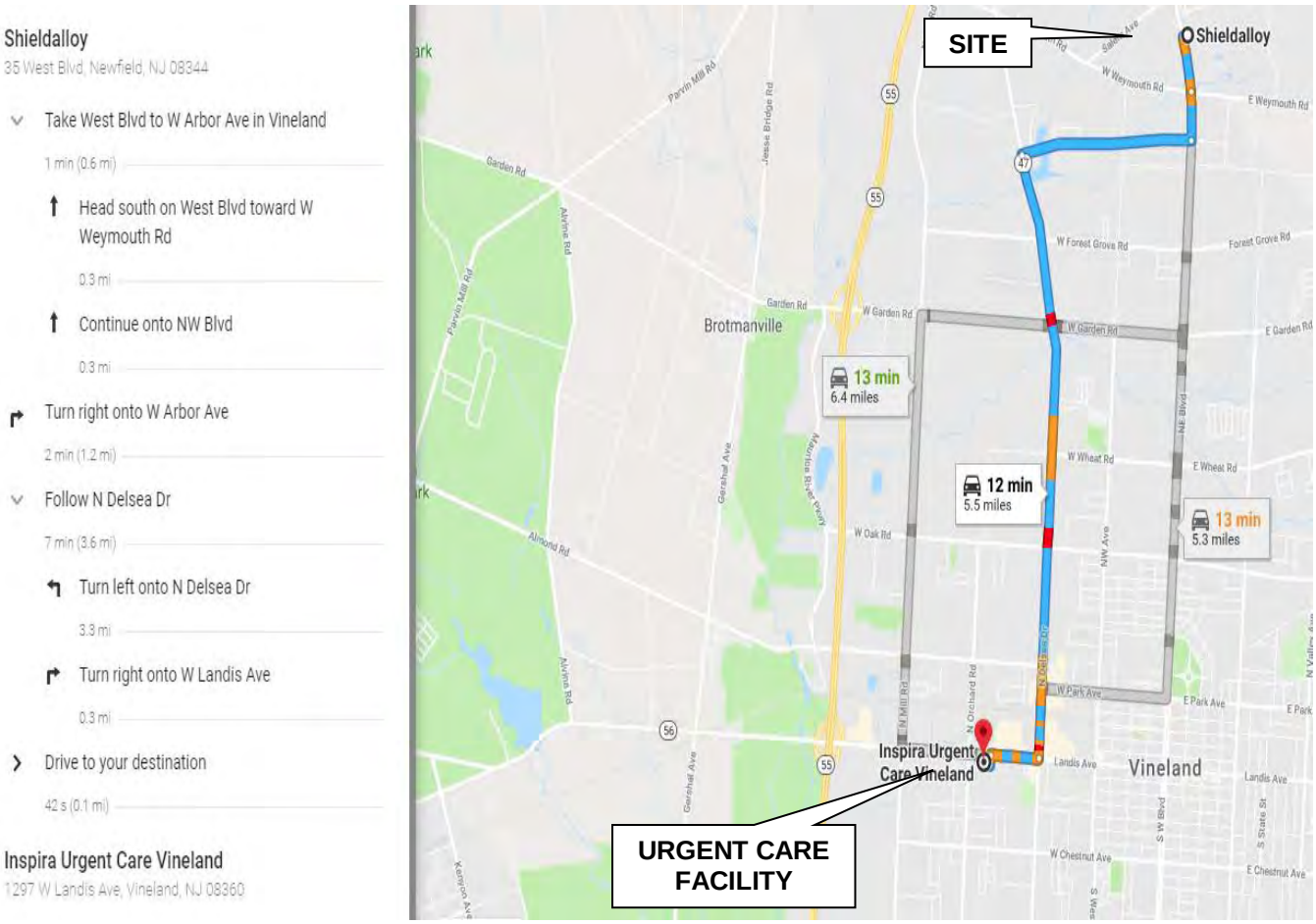
29 s (0.1 mi)

7. Turn right — 217 ft
8. Turn left
   Destination will be on the right — 285 ft

Inspira Medical Center Vineland

Inspira Medical Center Vineland
10.1 miles, 14 minutes
(856) 641-8000
1505 W Sherman Ave
Vineland, NJ 08360

ROUTE TO URGENT CARE FACILITY



Inspira Urgent Care
5.5 miles, 12 minutes
(856) 507-8548
1297 W Landis Ave
Vineland, NJ 08360

Appendix C: Summary of Chemical Hazards

Volatile Organic Compounds (VOCs)

Chlorinated VOCs are widely used as solvents in industrial operations such as degreasing, manufacturing, cleaning and dry cleaning, and are also present in household products and automotive fluids. They readily form vapors which can accumulate in indoor air spaces (i.e., via migration through the subsurface) and react with ozone to form sub-micron sized particles with the potential to cause adverse respiratory health effects. Free product releases (via surface or subsurface discharges or inadequate disposal) can migrate downward to significant depths and through fine-grained deposits to groundwater, and can persist as wide-scale sources of vapor plumes for long periods of time.

Several chlorinated hydrocarbons have been identified in soil, indoor air vapor, and groundwater at the Site including perchloroethylene (PCE), trichloroethylene (TCE), and 1,2-dichloroethane (DCA). The likely routes of exposure to chlorinated solvents include inhalation, ingestion and direct contact with the skin or eye. The toxicity of chlorinated solvents varies; many affect the central nervous system (CNS) and some are identified as carcinogens. PCE can affect the CNS and cause irritation of the skin, eyes, and upper respiratory tract. TCE can depress the CNS, affect kidneys, liver, and lungs and can cause rapid and irregular heartbeat. Toxic effects are increased when combined with alcohol, caffeine, and other drugs. DCA can cause CNS depression and damage to the liver, kidneys, heart, and digestive system. Eye contact with DCA can cause irritation and serious injury if not removed promptly. DCA and TCE are flammable liquids; the lower explosive limit (LEL) of both solvents are approximately 6% and their flash points are less than 100°F. PCE is not considered flammable. These chlorinated solvents are only slightly soluble in water.

Exposure levels will be maintained below OSHA PEL or NIOSH REL as shown in the table below.

Chemical Name	PEL[1]	REL[2]
1,2 DCA	50	1
TCE	100	Ca
PCE	100	Ca

[1] OSHA Permissible Exposure Limit (PEL) in parts per million
[2] Recommended Exposure Limit (REL); ACGIH Threshold Limit Value (TLV) in parts per million
Ca = Carcinogenic

Perchlorate

The perchlorate compound used in manufacturing processes on-Site is potassium perchlorate. Potassium perchlorate is a colorless crystal or white crystalline powder, and colorless when in

solution. Concentrated perchlorate is a strong oxidizer and can be a severe fire hazard. Perchlorate is a Site contaminant of concern in groundwater.

The primary exposure routes for perchlorate during work activities are ingestion of contaminated groundwater. Perchlorate is readily adsorbed after oral exposure and can migrate from the stomach and intestines to the bloodstream. The thyroid gland is the primary target of perchlorate toxicity in humans. Perchlorate can interfere with iodide uptake into the thyroid gland at high enough exposures, disrupting the functions of the thyroid and potentially leading to a reduction in the production of thyroid hormones (Agency for Toxic Substances and Disease Registry, 2008). Short-term exposure to high doses of ammonium-, sodium- or potassium- perchlorate may cause eye, skin and respiratory tract irritation, coughing, nausea, vomiting and diarrhea. Perchloric acid is corrosive to the eyes, skin and respiratory tract, and short-term exposure to high doses may cause sore throat, coughing, labored breathing, deep burns, loss of vision, abdominal pain, vomiting or diarrhea (National Institute for Occupational Safety and Health, 2013).

Radioactivity

Radioactive materials are known to have been present at the Site. Potentially radioactive soil and slag have been moved to a fenced off exclusion zone at the Site. It is not anticipated that Geosyntec personnel will come into contact with any radioactive materials during the work addressed by this HASP. Geosyntec personnel should not enter the exclusion zone.

Possible symptoms of exposure to radioactivity are: lacrimation, conjunctivitis, shortness of breath, cough, chest crackles, nausea, vomiting, skin burns, red blood cell casts in urine, albuminuria, and high blood urea nitrogen.

Appendix D: Air Monitoring

Applies to Task: ☒ ① ☐ ② ☐ ③ ☐ ④ ☐ ⑤ ☐ ⑥ ☐ ⑦ ☐ ⑧

☒ *Photoionization Detector (PID)*

Brand/Model No.: MiniRAE 3000 eV: 10.6

Monitoring Frequency: _Continuous

Breathing Zone Reading (ppm)	Action
0 to 1	Level D PPE
Greater than 1	Stop work. Evacuate the area. If upon return, levels still exceed the action level, stop work and implement engineering controls.

Note: _____

☐ *Oxygen (O_2) Meter*

Brand/Model No.: _____

Monitoring Frequency: _____

Reading (%)	Action
Less than 19.5	Stop work. Evacuate the area.
19.5 to 23.5	Continue to work with caution.
Greater than 23.5	Stop work. Evacuate the area.

Note: _____

☐ *Explosimeter*

Brand/Model No.: _____

Monitoring Frequency: _____

Source (% LEL)

Reading	Action
1 to 10	Continue with caution.
Greater than 10	Stop work. Evacuate the area. If upon return, concentration still exceeds 10% LEL, ventilate until concentration is back to <10% LEL.

Note: _____

☐ *Flame Ionization Detector (FID)*

Brand/Model No.: _____

Monitoring Frequency: _____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed _, stop work and implement engineering controls.

Note: _____

☐ *Chemical Detector Tube*

Brand/Model No.: _____

Monitoring Frequency: _____

Breathing Zone Reading (ppm)	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed _, stop work and implement engineering controls.

Note: _____

☐ *Other*

Brand/Model No.: _____

Monitoring Frequency: _____

Breathing Zone Reading	Action
_____ to _____	Level D PPE
_____ to _____	Level C PPE
Greater than _____	Stop work. Evacuate the area. If upon return, levels still exceed _, stop work and implement engineering controls.

Note: _____

Appendix E: Personal Protective Equipment

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Level per Task:	☒ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C	☐ D ☐ C

Modified Level D		***Level C***	
Equipment	***Material/Type***	***Equipment***	***Material/Type***
☒ Safety glasses	ANSI Z87.1-2010	☐ Full-face air-purifying respirator	Cartridge Type:
☒ Hard-toed boots	OSHA 1910.136	☐ Half-mask air-purifying respirator	Cartridge Type:
☐ Protective clothing	Fire Resistant (FR) Clothing	☐ Safety glasses	
☒ Hard hat*		☐ Hard-toed boots	
☐ Hearing protection*		☐ Protective clothing	
☒ High-visibility vest*	ANSI 107: Class 1	☐ Hard hat	
☐ Outer boots*		☐ Hearing protection*	
☒ Outer gloves*	Nitrile	☐ High-visibility vest*	
		☐ Outer boots*	
		☐ Outer gloves*	
		☐ Inner gloves*	

* PPE items may be downgraded (only with concurrence of SHSO and PM).

	Task ①	Task ②	Task ③	Task ④	Task ⑤	Task ⑥	Task ⑦	Task ⑧
Potential PPE Level per Task:	D C	D C	D C	D C	D C	D C	D C	D C

Appendix F: Safety Data Sheets

Included in this HASP	Chemical
☐	Acetone
☒	Alconox
☐	Ammonia
☐	Bentonite
☐	Diesel Fuel Oil No. 2-D
☐	Gasoline
☐	Helium
☐	Hexane
☐	Hydrochloric Acid
☐	Hydrogen
☒	Isobutylene Calibration Gas
☐	Isopropyl Alcohol
☐	KB-1
☐	Methane Calibration Gas
☐	Nitric Acid
☐	Permanganate
☐	Portland Cement
☐	Sulfuric Acid
☐	Other: _____
☐	Other: _____
☐	Other: _____
☐	Other: _____

Note: SDSs are presented on the following pages.

ALCONOX MSDS

Section 1 : MANUFACTURER INFORMATION

Product name: Alconox

Supplier: Same as manufacturer.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Supplier MSDS date: 2009/04/20

D.O.T. Classification: Not regulated.

Section 2 : HAZARDOUS INGREDIENTS

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE
497-19-8	7-13	SODIUM CARBONATE	NOT AVAILABLE	4090 MG/KG RAT ORAL 6600 MG/KG MOUSE ORAL	2300 MG/M3/2H RAT INHALATION 1200 MG/M3/2H MOUSE INHALATION
7722-88-5	10-30	TETRASODIUM PYROPHOSPHATE	5 MG/M3	4000 MG/KG RAT ORAL 2980 MG/KG MOUSE ORAL	NOT AVAILABLE
7758-29-4	10-30	SODIUM PHOSPHATE	NOT AVAILABLE	3120 MG/KG RAT ORAL 3100 MG/KG MOUSE ORAL >4640 MG/KG RABBIT DERMAL	NOT AVAILABLE

Section 2A : ADDITIONAL INGREDIENT INFORMATION

Note: (supplier).
CAS# 497-19-8: LD50 4020 mg/kg - rat oral.
CAS# 7758-29-4: LD50 3100 mg/kg - rat oral.

Section 3 : PHYSICAL / CHEMICAL CHARACTERISTICS

Physical state: Solid

Appearance & odor: Almost odourless.
White granular powder.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): Not applicable.

Vapour density (air=1): Not applicable.

By weight: Not available.

Evaporation rate (butyl acetate = 1): Not applicable.

Boiling point (°C): Not applicable.

Freezing point (°C): Not applicable.

pH: (1% aqueous solution).
9.5

Specific gravity @ 20 °C: (water = 1).
0.85 - 1.10

Solubility in water (%): 100 - > 10% w/w

Coefficient of water\oil dist.: Not available.

VOC: None

Section 4 : FIRE AND EXPLOSION HAZARD DATA

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Not available.

Sensitivity to mechanical impact: Not applicable.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: None

Section 5 : REACTIVITY DATA

Chemical stability: Stable under normal conditions.

Conditions of instability: None known.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizers.

Hazardous decomposition products: See hazardous combustion products.

Section 6 : HEALTH HAZARD DATA

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of Acute Exposure

Eye contact: May cause irritation.

Skin contact: Prolonged contact may cause irritation.

Inhalation: Airborne particles may cause irritation.

Ingestion: May cause vomiting and diarrhea.
May cause abdominal pain.
May cause gastric distress.

Effects of chronic exposure: Contains an ingredient which may be corrosive.

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available for mixture, see the ingredients section.

Exposure limit of material: Not available for mixture, see the ingredients section.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Medical conditions aggravated by exposure: Not available.

First Aid

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
Seek medical attention if symptoms persist.

Ingestion: Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.
Do not induce vomiting, seek immediate medical attention.

Section 7 : PRECAUTIONS FOR SAFE HANDLING AND USE

Leak / Spill: Contain the spill.
Recover uncontaminated material for re-use.
Wear appropriate protective equipment.
Contaminated material should be swept or shoveled into appropriate waste container for disposal.

Waste disposal: In accordance with municipal, provincial and federal regulations.

Handling procedures and equipment: Protect against physical damage.
Avoid breathing dust.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Launder contaminated clothing prior to reuse.

Storage requirements: Keep containers closed when not in use.
Store away from strong acids or oxidizers.
Store in a cool, dry and well ventilated area.

Section 8 : CONTROL MEASURES

Precautionary Measures

Gloves / Type:

Neoprene or rubber gloves.

Respiratory / Type:

If exposure limit is exceeded, wear a NIOSH approved respirator.

Eye / Type:

Safety glasses with side-shields.

Footwear / Type: Safety shoes per local regulations.

Clothing / Type: As required to prevent skin contact.

Other / Type: Eye wash capability should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.

MATERIAL SAFETY DATA SHEET
29 CFR 1910.1200 OSHA Hazard
Communication Rule Format
Chem-Tel 24 Hour Emergency # 1-800-255-3924

MINE SAFETY APPLIANCES COMPANY
P.O. Box 426
Pittsburgh, PA 15230
PHONE (412) 967-3000

This product contains isobutylene, oxygen and nitrogen, substances subject to the Pennsylvania Worker and Community Right-To-Know Act.

PRODUCT IDENTITY

LABEL IDENTITY - MSA P/N 10028038 Calibration Check Gas, 100 ppm Isobutylene in Air

CHEMICAL NAME - Isobutylene, Oxygen, Nitrogen Mixture

ADDITIONAL IDENTITIES - MSA P/N 10028038 Calibration Gas

FORMULA - C_4H_8 in Air

APPLICABLE CHEMICAL CONTENTS

	ppm	TWA
Isobutylene (CAS 115-11-7)	100	None
Air	Balance	None

NOTE: Gas under pressure, 1000 PSIG at 70°F, Approx. 100 Liters gas at atmospheric pressure

PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR - Colorless odorless gas.

BOILING POINT - N/A

SPECIFIC GRAVITY (H_2O = 1) - N/A

VAPOR PRESSURE - N/A

PERCENT VOLATILE BY VOLUME - N/A

VAPOR DENSITY (AIR = 1) - > 1

SOLUBILITY IN WATER - Isobutylene - Insoluble
Oxygen - 3.2 cm^3/100 ml (25°C)
Nitrogen - 2.3 cm^3/100 ml (0°C)

N/A - Not Applicable

PHYSICAL HAZARD INFORMATION

PHYSICAL HAZARD - Compressed gas, 1000 PSIG at 70°F

CONDITIONS OR MATERIALS TO AVOID - None

FLASH POINT - N/A LEL - N/A UEL - N/A

EXTINGUISHING MEDIA - This calibration gas mixture is not flammable. Use extinguishing media appropriate to surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES - See Next Item

UNUSUAL FIRE AND EXPLOSION HAZARDS - Gas under pressure, 1000 PSIG at 70°F. Do not exceed 120°F.

HEALTH HAZARDS

HEALTH HAZARDS - None Known for 100 ppm Isobutylene in Air. Isobutylene Inhalation Rat LC50: 620 Gm/M^3/4H. Isobutylene Inhalation Mouse LC50: 415 gm/M^3/2H.

SIGNS AND SYMPTOMS OF EXPOSURE - N/A to this gas mixture.

PRIMARY ROUTES OF ENTRY - Inhalation

TARGET ORGANS - Isobutylene is an asphyxiant, which displaces oxygen in the environment..

MEDICAL CONDITIONS GENERALLY RECOGNIZED AS BEING AGGRAVATED BY EXPOSURE - No information

EXPOSURE LIMITS - None (ACGIH 2009)

CARCINOGENICITY DATA - Component gases are not listed by NIOSH RTECS, OSHA, NTP or IARC.

EMERGENCY AND FIRST AID PROCEDURES - None

SAFE HANDLING AND USE

HYGIENIC PRACTICES - Avoid breathing gas.

PROTECTIVE MEASURES DURING REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT - N/A

PROCEDURES FOR SPILL OR LEAK CLEANUP - Ventilate area

WASTE DISPOSAL - Do not puncture or incinerate cylinder. Before discarding cylinder, slowly release contents to a safe exhaust. Dispose of cylinder in accordance with local, state and federal regulations

STORAGE - Store in a cool, dry, well-ventilated area. Do not exceed 120°F.

CONTROL MEASURES

PERSONAL PROTECTIVE EQUIPMENT - Due to the limited amount of gas in the cylinder, and the low release rate employed in instrument calibration, respiratory protection is not indicated under conditions of intended use.

ENGINEERING CONTROLS - Mechanical ventilation is suitable.

WORK PRACTICES - Avoid breathing gas. Use in well-ventilated areas. Follow the calibration procedure detailed in the MSA instruction manual provided with the instrument under calibration.

DATE OF PREPARATION - Rev. 2, April 2009

SAFETY DATA SHEET

1. Identification

Product identifier	**POTASSIUM PERCHLORATE, REAGENT (ACS)**	
Other means of identification		
Product code	80	
CAS number	7778-74-7	
Recommended use	professional, scientific and technical activities: other professional, scientific and technical activities	
Recommended restrictions	None known.	
Manufacturer/Importer/Supplier/Distributor information		
Manufacturer		
Company name	GFS Chemicals, Inc.	
Address	P.O. Box 245 Powell, OH 43065 United States	
Telephone	Phone Toll Free Fax	740-881-5501 800-858-9682 740-881-5989
Website	www.gfschemicals.com	
E-mail	service@gfschemicals.com	
Emergency phone number	Emergency Assistance	Chemtrec 800-424-9300

2. Hazard(s) identification

Physical hazards	Oxidizing solids	Category 1
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 2A
	Specific target organ toxicity, repeated exposure	Category 1
Environmental hazards	Not classified.	
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	May cause fire or explosion; strong oxidizer. Harmful if swallowed. Causes skin irritation. Causes serious eye irritation. Causes damage to organs through prolonged or repeated exposure.
Precautionary statement	
Prevention	Keep away from heat. Keep away from clothing and other combustible materials. Take any precaution to avoid mixing with combustibles. Do not breathe dust. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Wear protective gloves/eye protection/face protection. Wear fire/flame resistant/retardant clothing.
Response	IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell. Rinse mouth. IF ON SKIN: Wash with plenty of soap and water. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If on clothing: Rinse immediately contaminated clothing and skin with plenty of water before removing clothes. Get medical advice/attention if you feel unwell. If skin irritation occurs: Get medical advice/attention. If eye irritation persists: Get medical advice/attention. In case of fire: Use water to extinguish. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.
Storage	Keep cool. Store in a well-ventilated place. Keep container tightly closed. Store away from incompatible materials.

Disposal	Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Substances

Chemical name	Common name and synonyms	CAS number	%
POTASSIUM PERCHLORATE		7778-74-7	100

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	IF ON CLOTHING: rinse immediately contaminated clothing and skin with plenty of water before removing clothes. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention. Wash contaminated clothing before reuse.
Eye contact	Do not rub eyes. Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical advice/attention if you feel unwell.
Most important symptoms/effects, acute and delayed	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Dusts may irritate the respiratory tract, skin and eyes. Skin irritation. May cause redness and pain. Prolonged exposure may cause chronic effects.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off all contaminated clothing immediately. Contact with combustible material may cause fire. If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Water. Water spray.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Greatly increases the burning rate of combustible materials. Containers may explode when heated. During fire, gases hazardous to health may be formed. May ignite combustibles (wood, paper, oil, clothing, etc.).
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion. Move containers from fire area if you can do so without risk. Use water spray to cool unopened containers.
Specific methods	Cool containers exposed to flames with water until well after the fire is out.
General fire hazards	May cause fire or explosion; strong oxidizer. Contact with combustible material may cause fire.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep away from clothing and other combustible materials. Wear appropriate protective equipment and clothing during clean-up. Do not breathe dust. Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up	Do not clean up or dispose of except under supervision of a specialist. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Stop leak if you can do so without risk. Use water spray to reduce vapors or divert vapor cloud drift. Dilute with water. Prevent entry into waterways, sewers, basements or confined areas. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Ventilate the contaminated area. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Minimize dust generation and accumulation. If sweeping of a contaminated area is necessary use a dust suppressant agent which does not react with the product. Collect dust using a vacuum cleaner equipped with HEPA filter. Wear appropriate protective equipment and clothing during clean-up. This product is miscible in water. Should not be released into the environment. Collect dust or particulates using a vacuum cleaner with a HEPA filter. Clean up in accordance with all applicable regulations. Large Spills: Wet down with water and dike for later disposal. Absorb in vermiculite, dry sand or earth and place into containers. Shovel the material into waste container. Following product recovery, flush area with water. Small Spills: Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Minimize dust generation and accumulation. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Keep away from heat. Provide appropriate exhaust ventilation at places where dust is formed. Take any precaution to avoid mixing with combustibles. Keep away from clothing and other combustible materials. Do not breathe dust. Do not taste or swallow. Avoid contact with eyes, skin, and clothing. When using, do not eat, drink or smoke. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Keep away from heat. Store in a cool, dry place out of direct sunlight. Store in original tightly closed container. Store in a well-ventilated place. Do not store near combustible materials. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits	This substance has no PEL, TLV, or other recommended exposure limit.
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. If material is ground, cut, or used in any operation which may generate dusts, use appropriate local exhaust ventilation to keep exposures below the recommended exposure limits. Provide eyewash station. Eye wash fountain and emergency showers are recommended.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	
Hand protection	Wear appropriate chemical resistant gloves. Frequent change is advisable.
Other	Wear appropriate chemical resistant clothing. Use of an impervious apron is recommended. Wear fire/flame resistant/retardant clothing.
Respiratory protection	Use a NIOSH/MSHA approved respirator if there is a risk of exposure to dust/fume at levels exceeding the exposure limits. Wear respirator with dust filter.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Keep away from food and drink. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Solid.
Form	Crystalline powder.
Color	White.
Odor	Odorless.
Odor threshold	Not available.

pH	Not available.
Melting point/freezing point	977 °F (525 °C)
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	20 g/l at 25 °C
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	977 °F (525 °C)
Viscosity	Not available.
Other information	
Density	2.53 g/cm3
Explosive properties	Not explosive.
Molecular formula	KClO4
Molecular weight	138.55 g/mol
Oxidizing properties	May cause fire or explosion; strong oxidizer.
Specific gravity	2.53

10. Stability and reactivity

Reactivity	May ignite or explode on contact with combustible materials.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat. Contact with incompatible materials.
Incompatible materials	Strong acids. Combustible material. Reducing agents.
Hazardous decomposition products	Chlorine.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause damage to organs through prolonged or repeated exposure by inhalation. Dust may irritate respiratory system.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye irritation.
Ingestion	Harmful if swallowed.
Symptoms related to the physical, chemical and toxicological characteristics	Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Dusts may irritate the respiratory tract, skin and eyes. Skin irritation. May cause redness and pain.

Information on toxicological effects

Acute toxicity	Harmful if swallowed.
Skin corrosion/irritation	Causes skin irritation.

Serious eye damage/eye irritation Causes serious eye irritation.

Respiratory or skin sensitization

Respiratory sensitization Not a respiratory sensitizer.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Causes damage to organs through prolonged or repeated exposure. The perchlorate ion competes with iodide in the mechanism that governs uptake into the thyroid gland for growth hormone production. This effect is routinely countered by ensuring sufficient dietary intake of iodine, as perchlorate does not accumulate in the body. Studies on workers in plants where perchlorates are manufactured have shown no thyroid abnormalities; various clinical studies are ongoing. Perchlorates occur naturally in trace amounts in the environment, and are not classified as carcinogenic.

Aspiration hazard Not an aspiration hazard.

Chronic effects Causes damage to organs through prolonged or repeated exposure.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Product		Species	Test Results
POTASSIUM PERCHLORATE (CAS 7778-74-7)			
Aquatic			
Crustacea	LC50	Water flea (Daphnia magna)	670 mg/l, 24 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability None known.

Bioaccumulative potential No data available.

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations. Dilute waste in large quantities of water and flush into sewer connected to wastewater treatment system in compliance with applicable laws and regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number UN1489

UN proper shipping name Potassium perchlorate

Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Label(s)	5.1
Packing group	II
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	IB6, IP2, T3, TP33
Packaging exceptions	152
Packaging non bulk	212
Packaging bulk	242

IATA

UN number	UN1489
UN proper shipping name	Potassium perchlorate
Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Packing group	II
Environmental hazards	No.
ERG Code	5L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Passenger and cargo aircraft	Allowed with restrictions.
Cargo aircraft only	Allowed with restrictions.

IMDG

UN number	UN1489
UN proper shipping name	POTASSIUM PERCHLORATE
Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Packing group	II
Environmental hazards	
Marine pollutant	No.
EmS	F-H, S-Q
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

DOT

IATA; IMDG

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)
Contaminate candidate list
Monitoring

US state regulations California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
Taiwan	Taiwan Toxic Chemical Substances (TCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date December-04-2014

Revision date October-17-2017

Version # 02

Disclaimer	GFS Chemicals, Inc. cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.
Revision information	This document has undergone significant changes and should be reviewed in its entirety.

ATTACHMENT A

Previous Perchlorate Analytical Results

TABLE 2-1
Groundwater Perchlorate Results Summary - 2004 Through 2011
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

WELL IDENTIFIER	SCREENED INTERVAL (FTBGS)[1]	RELATIVE AQUIFER DEPTH	PERCHLORATE (µg/L) SAMPLING EVENT							
			JULY 27, 2004	SEPTEMBER 10, 2004	SEPTEMBER 30, 2004	OCTOBER 27, 2004	FEBRUARY 21, 2006	OCTOBER 20-22, 2009[2]	SEPTEMBER 8-9, 2010	APRIL 29, 2011
ON-SITE MONITORING WELLS										
IWC-1	15-20	Shallow	**9.9**	**10.0**	NA	NA	NA	**7.3**	NA	NA
IWC-2	35-40	Shallow	**10**	**9.4**	NA	NA	NA	**7.7**	NA	NA
IWC-3	55-60	Intermediate	4.0 / 4.1	4.0 / 4.0	NA	NA	NA	2.5 J [3]	NA	NA
IWC-4	75-80	Intermediate	**5.4**	**6.9**	NA	NA	NA	4.6	4.4	NA
IWC-5	95-100	Deep	**10.0**	**11.0**	NA	NA	NA	**11.7 / 10.7**[4]	NA	NA
A	114-124	Deep	NA	<0.18	NA	NA	NA	<3.0	NA	NA
B	36-46	Shallow	NA	**8.0**	NA	NA	NA	1.2 J [3]	NA	NA
K	36-46	Shallow	NA	NA	NA	NA	NA	**90.5 / 78.1**	1.9 J[6] / 3.0	NA
L	42-52	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC9S	15-30	Shallow	NA	**8.0**	NA	NA	NA	**8.2 / 8.0**[5]	NA	NA
SC11S(R)	9-24	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC12S	15-25	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC12D	126-136	Deep	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC13S(R)	14.7-24.7	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC13D	127-137	Deep	NA	NA	NA	NA	NA	2.2 J [6]	NA	NA
SC14S	12-27	Shallow	NA	0.21 J	NA	NA	NA	<3.0	<3.0	NA
SC15S	12.5-27.5	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC16S	12-27	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC20S	7-22	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC20D	129-139	Deep	NA	NA	NA	NA	NA	**7.0**	**6.0**	NA
SC22S	3-18	Shallow	NA	NA	NA	NA	NA	<3.0	2.0 J[6]	NA
SC23S	9-24	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC25S	7-22	Shallow	NA	NA	NA	NA	NA	<3.0	0.64 J[6]	NA
SC27S	7-22	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
MWH-4	119-129	Deep	NA	NA	NA	NA	NA	<3.0	NA	NA
W2(R)	2-17	Shallow	NA	NA	NA	NA	NA	0.94 J [6]	<3.0	NA
W3D	88-108	Deep	NA	NA	NA	NA	NA	**8.6**	**7.4**	NA
W4	55-75	Intermediate	NA	NA	NA	NA	NA	1.2 J[6]	0.93 J[6]	NA

NOTES:

(1) - FTBGS, Feet Below Ground Surface
(2) - Monitoring wells SC33D & SC34D were sampled on 11/19/09, monitoring wells SC35D & SC36D were sampled on 12/7/09, monitoring well K was re-sampled on 1/21/10, & recovery wells Layne & W9 were sampled on 1/21/10
(3) - Data qualifier changed to "J" by data validation
(4) - "Blind" duplicate sample labeled as IWC-6
(5) - "Blind" duplicate sample labeled as SC33S
(6) - Data not validated, but qualifier changed to "J" consistent with data validation
(7) - Data validation corrected reporting limit
(8) - "Blind" duplicate sample labeled as SC35D
(9) - "Blind" duplicate sample labeled as SC37D
(10) - "Blind" duplicate sample labeled as SC34D

µg/L - micrograms per liter
NA - Not Analyzed
All samples were analyzed by EPA Method 314.0
BOLD - indicates that value is greater than the perchlorate action level of 5 µg/L (2006 ACO)
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
J - Indicates a result is less than the reporting limit and estimated by the laboratory
Results with slash (e.g., 13.0 / 12.9) indicate duplicate results

TABLE 2-1
Groundwater Perchlorate Results Summary - 2004 Through 2011
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

WELL IDENTIFIER	SCREENED INTERVAL (FTBGS)[1]	RELATIVE AQUIFER DEPTH	PERCHLORATE (µg/L) SAMPLING EVENT							
			JULY 27, 2004	SEPTEMBER 10, 2004	SEPTEMBER 30, 2004	OCTOBER 27, 2004	FEBRUARY 21, 2006	OCTOBER 20-22, 2009[2]	SEPTEMBER 8-9, 2010	APRIL 29, 2011
OFF-SITE MONITORING WELLS										
OBS-2A	129-149	Deep	NA	NA	NA	NA	NA	4.8 J [6]	NA	NA
IW1	32-62	Intermediate	NA	NA	NA	NA	NA	1.1 J [6]	NA	NA
SC4S	35-45	Shallow	NA	NA	1.1	NA	NA	<3.0	NA	NA
SC6S	45-75	Intermediate	NA	NA	1.6	NA	NA	**6.4**	**19.6**	NA
SC6D	110-120	Deep	NA	NA	3.5	NA	NA	**9.8**	NA	NA
SC10S	35-55	Shallow	NA	NA	NA	NA	NA	1.7 J [6]	<3.0	NA
SC10D	105-125	Deep	NA	NA	NA	NA	NA	**19.5**	**8.5**	NA
SC17S	19-28	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC17D	143-153	Deep	NA	NA	NA	NA	NA	**6.3**	**5.6**	NA
SC18S	4-19	Shallow	NA	NA	NA	NA	NA	<15.0 [7]	<3.0	NA
SC18D	119-129	Deep	NA	NA	NA	NA	NA	3.8	NA	NA
SC19S	2-17	Shallow	NA	NA	NA	NA	NA	<3.0	NA	NA
SC19D	120-130	Deep	NA	NA	NA	NA	NA	**14.3**	NA	NA
SC21S	3-18	Shallow	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC21D	125-135	Deep	NA	NA	NA	NA	NA	**29.1**	**32.8**	NA
SC26D	127-137	Deep	NA	NA	NA	NA	NA	**11.0**	**6.8**	NA
SC28D	133-153	Deep	NA	NA	NA	**34.0**	NA	**49.0**	**16.8**	NA
SC30D	147-157	Deep	NA	NA	NA	1.9	NA	2.6 J [6]	2.8 J[6]	NA
SC32D	92-102	Deep	NA	NA	NA	NA	NA	3.2 / 3.3[8]	3.7	NA
SC33D	82.5-92.5	Intermediate	NA	NA	NA	NA	NA	<3.0	<3.0	NA
SC34D	130-140	Deep	NA	NA	NA	NA	NA	**150 / 152[9]**	**158**	NA
SC35D	89.5-99.5	Deep	NA	NA	NA	NA	NA	2.0 J [6]	2.7 J[6]	NA
SC36D	107-117	Deep	NA	NA	NA	NA	NA	**5.3**	**6.4 / 5.6[9]**	NA
SC40D	120-130	Deep	NA	NA	NA	NA	NA	NA	NA	4.0 / 3.9 [11]
ON-SITE EXTRACTION WELLS										
Layne	42-47	Shallow	NA	**23.0**	NA	NA	NA	**67.4**	**36.6**	NA
W9	110-130	Deep	NA	**10.0**	NA	NA	NA	**6.1**	NA	NA

NOTES:

(1) - FTBGS, Feet Below Ground Surface
(2) - Monitoring wells SC33D & SC34D were sampled on 11/19/09, monitoring wells SC35D & SC36D were sampled on 12/7/09, monitoring well K was re-sampled on 1/21/10, & recovery wells Layne & W9 were sampled on 1/21/10
(3) - Data qualifier changed to "J" by data validation
(4) - "Blind" duplicate sample labeled as IWC-6
(5) - "Blind" duplicate sample labeled as SC33S
(6) - Data not validated, but qualifier changed to "J" consistent with data validation
(7) - Data validation corrected reporting limit
(8) - "Blind" duplicate sample labeled as SC35D
(9) - "Blind" duplicate sample labeled as SC37D
(10) - "Blind" duplicate sample labeled as SC34D
(11) - "Blind" duplicate sample labeled as SC49D

µg/L - micrograms per liter
NA - Not Analyzed
All samples were analyzed by EPA Method 314.0
BOLD - indicates that value is greater than the perchlorate action level of 5 µg/L (2006 ACO)
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
J - Indicates a result is less than the reporting limit and estimated by the laboratory
Results with slash (e.g., 13.0 / 12.9) indicate duplicate results

TABLE 2-1
Groundwater Perchlorate Results Summary - 2004 Through 2011
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

WELL IDENTIFIER	SCREENED INTERVAL (FTBGS)[1]	RELATIVE AQUIFER DEPTH	PERCHLORATE (µg/L) SAMPLING EVENT							
			JULY 27, 2004	SEPTEMBER 10, 2004	SEPTEMBER 30, 2004	OCTOBER 27, 2004	FEBRUARY 21, 2006	OCTOBER 20-22, 2009[2]	SEPTEMBER 8-9, 2010	APRIL 29, 2011
FARM PARCEL MONITORING WELLS										
IW2	40-70	Intermediate	NA	NA	NA	NA	NA	3.7	NA	NA
SC1S	35-55	Intermediate	NA	NA	NA	3.5	**8.8**	1.8 J [3]	0.69 J[3]	NA
SC1D	85-95/100-115	Deep	NA	NA	NA	**76.0 / 76.0**	**53.9**	**46.3**	**44.5**	NA
SD2D(R)	106-116	Deep	NA	NA	**9.2**	NA	NA	**7.0**	**6.6**	NA
SC3S	35-55	Intermediate	NA	NA	**13**	NA	**20.9**	1.8 J [3]	**13.0**	NA
SC3D(R)	102-112	Deep	NA	NA	**49**	NA	**62.1**	**141 / 136[10]**	**143**	NA
SC5S	5-20	Shallow	NA	NA	NA	NA	NA	1.4 J [6]	NA	NA
SC5D	90-120	Deep	NA	NA	NA	NA	NA	1.2 J [6]	NA	NA
SC24S	5-20	Shallow	NA	NA	NA	4.8	4.3	0.99 J [6]	2.1 J[3]	NA
SC24D	105-115	Deep	NA	NA	NA	**6**	3.0	3.0	NA	NA
SC31D	120-130	Deep	NA	NA	NA	NA	NA	**6.6**	NA	NA
OFFSITE EXTRACTION WELLS										
RIW2	30-55	Shallow	NA	NA	**14.0 / 15.1**	NA	**9.4**	4.1	NA	NA
RW6S	55-75	Intermediate	NA	NA	**8.0 / 8.01**	NA	NA	**12.9**	NA	NA
RW6D	90-125	Deep	NA	NA	**12.0 / 13.8**	NA	NA	**14.3**	NA	NA

NOTES:

(1) - FTBGS, Feet Below Ground Surface
(2) - Monitoring wells SC33D & SC34D were sampled on 11/19/09, monitoring wells SC35D & SC36D were sampled on 12/7/09, monitoring well K was re-sampled on 1/21/10, & recovery wells Layne & W9 were sampled on 1/21/10
(3) - Data qualifier changed to "J" by data validation
(4) - "Blind" duplicate sample labeled as IWC-6
(5) - "Blind" duplicate sample labeled as SC33S
(6) - Data not validated, but qualifier changed to "J" consistent with data validation
(7) - Data validation corrected reporting limit
(8) - "Blind" duplicate sample labeled as SC35D
(9) - "Blind" duplicate sample labeled as SC37D
(10) - "Blind" duplicate sample labeled as SC34D

µg/L - micrograms per liter
NA - Not Analyzed / Not Applicable
All samples were analyzed by EPA Method 314.0
BOLD - indicates that value is greater than the perchlorate action level of 5 µg/L (2006 ACO)
Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L
J - Indicates a result is less than the reporting limit and estimated by the laboratory
Results with slash (e.g., 13.0 / 12.9) indicate duplicate results

TABLE 2-2
Current and Previous Off-Site Groundwater Vertical Profiling Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Approx. Ground Surface Elevation (ftmsl)	Sample Depth (ftbgs)	Approx. Sample Elevation (ftmsl)	Relative Aquifer Depth	Perchlorate (ug/L)
Vertical Profile Samples (2009 Investigation)						
VP-13 (25-30)	10/14/2009	102	25-30	77 to 72	Shallow	<3.0
VP-13 (50-55)	10/14/2009	102	50-55	52 to 47	Shallow	<3.0
VP-13 (75-80)	10/14/2009	102	75-80	27 to 22	Intermediate	3.9
VP-13 (100-105)	10/15/2009	102	100-105	2 to -3	Deep	**10.6**
VP-13 (125-130)	10/15/2009	102	125-130	-23 to -28	Deep	**5.7**
VP-13A (15-20)	10/22/2009	89	15-20	74 to 69	Shallow	<3.0
VP-13A (37-42)	10/22/2009	89	37-42	52 to 47	Shallow	<3.0
VP-13A (62-67)	10/22/2009	89	62-67	27 to 22	Intermediate	4.3
VP-13A (87-92)	10/23/2009	89	87-92	2 to -3	Deep	3.4
VP-13A (111-116)	10/23/2009	89	111-116	-22 to -27	Deep	**6.0**
VP-14 (35-40)	10/16/2009	100	35-40	65 to 60	Shallow	0.93 J (2)
VP-14 (55-60)	10/16/2009	100	55-60	45 to 40	Shallow	<3.0
VP-14 (80-85)	10/19/2009	100	80-85	20 to 15	Intermediate	1.6 J (1)
VP-14 (105-110)	10/19/2009	100	105-110	-5 to -10	Deep	**6.2**
VP-24 (105-110) Field Dup	10/19/2009	100	105-110	-5 to -10	Deep	**5.9**
VP-14 (130-135)	10/19/2009	100	130-135	-30 to -35	Deep	**12.5**
VP-15 (30-35)	10/12/2009	91	30-35	61 to 56	Shallow	<3.0
VP-15 (45-50)	10/12/2009	91	45-50	46 to 41	Shallow	<3.0
VP-15 (65-70)	10/13/2009	91	65-70	26 to 21	Intermediate	<3.0
VP-15 (88-93)	10/13/2009	91	88-93	3 to -2	Deep	4.9
VP-15 (114-119)	10/13/2009	91	114-119	-23 to -28	Deep	<3.0
VP-15A (15-20)	10/20/2009	76	15-20	61 to 56	Shallow	<3.0
VP-15A (38-43)	10/21/2009	76	38-43	38 to 33	Shallow	<3.0
VP-15A (55-60)	10/21/2009	76	55-60	21 to 16	Intermediate	<3.0
VP-15A (77-82)	10/21/2009	76	77-82	-1 to -6	Deep	1.6 J (2)
VP-15A (99-104)	10/21/2009	76	99-104	-23 to -28	Deep	2.5 J (2)
VP-25A (99-104) Field Dup	10/21/2009	76	99-104	-23 to -28	Deep	2.9 J (2)

NOTES:

(1) - Data qualifier changed to "J" by data validation

(2) - Data not validated, but qualifier changed to "J" consistent with data validation

BOLD - indicates that value is greater that the perchlorate action level of 5 µg/L

Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L

micrograms per Liter (µg/L) is equivalent to parts per billion

ftmsl - feet above mean sea level (NAVD 27)

ftbgs - feet below ground surface

J - Indicates a result is less than the reporting limit and estimated by the laboratory

TABLE 2-2
Current and Previous Off-Site Groundwater Vertical Profiling Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Approx. Ground Surface Elevation (ftmsl)	Sample Depth (ftbgs)	Approx. Sample Elevation (ftmsl)	Relative Aquifer Depth	Perchlorate (ug/L)
Vertical Profile Samples (2006/2007 Investigation)						
VP-1 (15-20)	11/28/2006	85	15-20	70 to 65	Shallow	<0.3
VP-1 (35-40)	11/28/2006	85	35-40	50 to 45	Shallow	<0.3
VP-1 (60-65)	11/29/2006	85	60-65	25 to 20	Intermediate	<0.3
VP-1 (85-90)	11/29/2006	85	85-90	0 to -5	Deep	**5.6**
VP-1 (105-110)	11/29/2006	85	105-110	-20 to -25	Deep	3.0
VP-2 (15-20)	11/30/2006	85	15-20	70 to 65	Shallow	<0.3
VP-2 (35-40)	12/1/2006	85	35-40	50 to 45	Shallow	4.2
VP-2 (60-65)	12/1/2006	85	60-65	25 to 20	Intermediate	**9.6**
VP-2 (85-90)	12/1/2006	85	85-90	0 to -5	Deep	**49.9**
VP-2 (110-115)	12/1/2006	85	110-115	-25 to -30	Deep	**9.4**
VP-3 (25-30)	12/4/2006	95	25-30	70 to 65	Shallow	<0.3
VP-3 (45-50)	12/5/2006	95	45-50	50 to 45	Shallow	<0.3
VP-30 (45-50) Field Dup	12/5/2006	95	45-50	50 to 45	Shallow	<0.3
VP-3 (70-75)	12/6/2006	95	70-75	25 to 20	Intermediate	**7.9**
VP-3 (95-100)	12/6/2006	95	95-100	0 to -5	Deep	**34**
VP-3 (115-120)	12/6/2006	95	115-120	-20 to -25	Deep	**28.3**
VP-4 (30-35)	12/11/2006	100	30-35	70 to 65	Shallow	1.3
VP-4 (50-55)	12/11/2006	100	50-55	50 to 45	Intermediate	1.3
VP-4 (75-80)	12/11/2006	100	75-80	25 to 20	Intermediate	3.3
VP-4 (75-80) Field Dup	12/11/2006	100	75-80	25 to 20	Intermediate	3.1
VP-4 (100-105)	12/11/2006	100	100-105	0 to -5	Deep	<0.3
VP-4 (121-126)	12/11/2006	100	121-126	-21 to -26	Deep	**6.8**
VP-10 (20-25)	12/15/2006	85	20-25	65 to 60	Shallow	2.4
VP-10 (35-40)	12/15/2006	85	35-40	50 to 45	Shallow	<0.3
VP-10 (60-65)	12/18/2006	85	60-65	25 to 20	Intermediate	3.4
VP-100 (60-65) Field Dup	12/18/2006	85	60-65	25 to 20	Intermediate	3.4
VP-10 (85-90)	12/18/2006	85	85-90	0 to -5	Deep	**17.4**
VP-10 (109-114)	12/18/2006	85	109-114	-24 to -29	Deep	**6.7**

NOTES:

(1) - Data qualifier changed to "J" by data validation

(2) - Data not validated, but qualifier changed to "J" consistent with data validation

BOLD - indicates that value is greater that the perchlorate action level of 5 µg/L

Shaded - Indicates that value is greater than the EPA Interim Health Advisory Level of 15 µg/L

micrograms per Liter (µg/L) is equivalent to parts per billion

ftmsl - feet above mean sea level (NAVD 27)

ftbgs - feet below ground surface

TABLE 2-3
Soil Investigation Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Sample Depth (ftbgs)	Perchlorate (ug/kg)
Background Sample			
SS-01 (0-1')	8/30/2012	0-1	<1.2
SS-01 (5-7')	10/26/2009	5-7	<9.6
SS-01 (12-14')	10/26/2009	12-14	<10
AOC-1 Former Chemical Storage Building			
SS-02 (1-3')	10/26/2009	1-3	2.1 J(1)
SS-02 (14-16')	10/26/2009	14-16	<9.7
SS-03 (0-2')	10/26/2009	0-2	<10
SS-03 (13-15')	10/26/2009	13-15	8.6 J(1)
SS-04 (0-1')	8/30/2012	0-1	<1.2
SS-04 (2-4')	10/26/2009	2-4	7.9 J(1)
SS-04 (14-16')	10/26/2009	14-16	4.2 J(1)
SS-05 (0-1')	8/30/2012	0-1	<1.2
SS-05 (5-7')	10/26/2009	5-7	58.3
SS-05 (13-15')	10/26/2009	13-15	18.3
SS-06 (1-3')	10/26/2009	1-3	<10
SS-06 (14-16')	10/26/2009	14-16	2.9 J(1)
SS-07 (6-8')	10/26/2009	6-8	<9.6
SS-27 (6-8') Field Dup	10/26/2009	6-8	<9.6
SS-07 (13-15')	10/26/2009	13-15	3.0 J(1)
SS-08 (3-4')	10/26/2009	3-4	<9.9
SS-08 (12-14')	10/26/2009	12-14	<9.6
AOC-2 Former Building D102(A)			
SS-21 (0-1')	8/30/2012	0-1	5.9 J(1)
SS-21 (1-3')	10/28/2009	1-3	11.0
SS-21 (5-7')	10/28/2009	5-7	10.7
SS-22 (1-3')	10/28/2009	1-3	<9.8
SS-22 (6-8')	10/28/2009	6-8	12.0
SS-23 (2-4')	10/28/2009	2-4	<10
SS-33 (2-4') Field Dup	10/28/2009	2-4	<10
SS-23 (6-8')	10/28/2009	6-8	<9.7
SS-24 (0-1')	8/30/2012	0-1	<1.2
SS-24 (1-3')	10/28/2009	1-3	26.5
SS-24 (4-6')	10/28/2009	4-6	28.8

Sample ID	Date Sampled	Sample Depth (ftbgs)	Perchlorate (ug/kg)
AOC-3 Former Lagoon Area			
SS-09 (0-1')	8/30/2012	0-1	<1.2
SS-09 (6-8')	10/26/2009	6-8	<10
SS-09 (12-14')	10/26/2009	12-14	<10
SS-10 (2-4')	10/26/2009	2-4	<9.8
SS-10 (4-6')	10/26/2009	4-6	<9.4
SS-11 (1-3')	10/27/2009	1-3	<9.8
SS-11 (5-7')	10/27/2009	5-7	2.8 J(2)
SS-12 (2-4')	10/27/2009	2-4	<9.7
SS-12 (5-7')	10/27/2009	5-7	<9.6
SS-32 (5-7') Field Dup	10/27/2009	5-7	<9.6
SS-13 (0-1')	8/30/2012	0-1	<1.2
SS-13 (1-3')	10/27/2009	1-3	2.0 J(2)
SS-13 (5-7')	10/27/2009	5-7	2.9 J(2)
SS-14 (1-3')	10/27/2009	1-3	<9.5
SS-14 (6-8')	10/27/2009	6-8	<9.6
SS-15 (0-1')	8/30/2012	0-1	<1.2
SS-15 (2-4')	10/27/2009	2-4	<9.7
SS-15 (4-6')	10/27/2009	4-6	<9.9
SS-16 (1-3')	10/27/2009	1-3	<9.6
SS-16 (6-8')	10/27/2009	6-8	<9.9
SS-17 (1-3')	10/27/2009	1-3	<9.7
SS-17 (5-7')	10/27/2009	5-7	2.8 J(2)
SS-18 (1-3')	10/27/2009	1-3	<10
SS-18 (6-8')	10/27/2009	6-8	<9.3
SS-19 (1-3')	10/27/2009	1-3	<9.8
SS-19 (6-8')	10/27/2009	6-8	<9.6
SS-20 (0-1')	8/30/2012	0-1	<1.2
SS-20 (1-3')	10/27/2009	1-3	2.3 J(2)
SS-20 (4-6')	10/27/2009	4-6	<10

NOTES:

(1) - Data qualifier changed to "J" by data validation

(2) - Data not validated, but qualifier changed to "J" consistent with data validation

EPA Regional Screening Level for perchlorate in residential soil is 55,000 µg/kg and 720,000 µg/kg in industrial soil.

Shaded results are in excess of the EPA Regional Screening Level for perchlorate.

micrograms per Liter (µg/kg) is equivalent to parts per billion

ftbgs - feet below ground surface

J - Indicates a result is less than the reporting limit and estimated by the laboratory

TABLE 2-4
Soil Investigation, Monitoring/Extraction Well Sampling, Groundwater Vertical Profiling, and Surface Water and Sediment QA/QC Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Perchlorate (µg/L)
Soil / Sediment Investigation Field Blank Samples		
FB102609(1)	10/26/2009	<3.0
FB102609(2)	10/26/2009	<3.0
FB102709(1)	10/27/2009	<3.0
FB102709(2)	10/27/2009	<3.0
FB102809(for SS Samples)	10/28/2009	<3.0
FB102809(for SED Samples)	10/28/2009	<3.0
Monitoring/Extraction Well Sampling Field Blank Samples		
FB102009A	10/20/2009	<3.0
FB102109	10/21/2009	<3.0
FB102209	10/22/2009	<3.0
FB111909	11/19/2009	<3.0
FB090810	9/8/2010	<3.0
FB090910	9/9/2010	<3.0
FB042911	4/29/2011	<3.0
Groundwater Vertical Profiling Field Blank Samples		
FB101209	10/12/2009	<3.0
FB101309	10/13/2009	<3.0
FB101409	10/14/2009	<3.0
FB101509	10/15/2009	<3.0
FB101609	10/16/2009	<3.0
FB101909	10/19/2009	<3.0
FB102009	10/20/2009	<3.0
FB102109	10/21/2009	<3.0
FB102209	10/22/2009	<3.0
FB102309	10/23/2009	<3.0
Environmental Samples / "Blind" Duplicate Samples		
Monitoring Well Sampling		
IWC-5 / IWC-6	10/21/2009	11.7 / 10.7
SC9S / SC33S	10/21/2009	8.2 / 8.0
SC32D / SC35D	10/22/2009	3.2 / 3.3
SC3D(R) / SC34D	10/21/2009	141 / 136
SC34D / SC37D	11/19/2009	150 / 152
SC36D / SC37D	9/8/2010	6.4 / 5.6
SC40D / SC49D	4/29/2011	4.0 / 3.9
K / J	9/9/2010	1.9J / 3.0
Groundwater Vertical Profiling		
VP-14(105-110) / VP-24(105-110)	10/19/2009	6.2 / 5.9
VP-15A(99-104) / VP-25A(99-104)	10/21/2009	2.5J / 2.9J
Soil Investigation*		
SS-07(6-8') / SS-27(6-8')	10/26/2009	<9.6 / <9.6
SS-12(5-7') / SS-32(5-7')	10/27/2009	<9.6 / <9.6
SS-23(2-4') / SS-33(2-4')	10/28/2009	<10 / <10
Surface Water / Sediment Investigation		
SED-4 / SED-10*	10/28/2009	10.9J / <42
SW-4 / SW-10	10/28/2009	<3.0 / <3.0

NOTES:

Action Level for Perchlorate is 5 µg/L (per Administrative Consent Order signed February 1, 2006).

micrograms per Liter (µg/L) is equivalent to parts per billion

J - Indicates a result is less than the reporting limit and estimated by the laboratory

* - Soil and sediment perchlorate results are presented in micrograms per kilogram (µg/kg)

TABLE 2-5
Surface Water and Sediment Investigation Perchlorate Results
Perchlorate Remedial Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

Sample ID	Date Sampled	Perchlorate	
		Surface Water (ug/l)	Sediment (ug/kg)
Surface Water / Sediment Sample Identifications			
SW-1A / SED-1A	10/28/2009	1.8 J (1)	<12
SW-1 / SED-1	10/28/2009	<3.0	<18
SW-2 / SED-2	10/28/2009	<3.0	<19 (2)
SW-3 / SED-3	10/28/2009	<3.0	<13
SW-4 / SED-4	10/28/2009	<3.0	10.9 J (1)
SW-10 / SED-10 Field Dup	10/28/2009	<3.0 (2)	<42
SW-5 / SED-5	10/28/2009	<3.0	<27
SW-6 / SED-6	10/28/2009	<3.0	<16
SW-7 / SED-7	10/29/2009	<3.0	<21
SED-8	10/29/2009	Dry	<11
SW-9 / SED-9	10/29/2009	<3.0	<47

NOTES:

(1) - Data qualifier changed to "J" by data validation

(2) - Data validation indicated analytical result should be reported as less than the laboratory reporting limit

There are no established guidance or criteria for perchlorate in surface water or sediment

micrograms per Liter (µg/L) is equivalent to parts per billion

ftmsl - feet above mean sea level (NAVD 27)

ftbgs - feet below ground surface

J - Indicates a result is less than the reporting limit and estimated by the laboratory

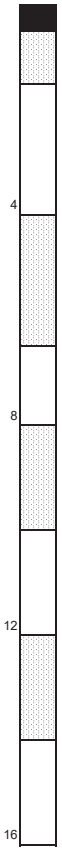
ATTACHMENT B

Relevant Boring Logs, Vertical Profiling Logs, and Well Construction Diagrams

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring: SS-01
Project Number: 171441.000050.000000	Drillers: Michael	Date Started: 10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed: 10/26/09
Boring Location: Background	Drill Equipment / Method: Geoprobe 66DT	

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	1.2	NA	0-0.3	TOPSOIL.
				0.3-1.2	Orange-brown F-M SAND, little c-gravel, trace silt, trace f-gravel.
				1.2-4	No Recovery.
4-8	4	2.6	NA	0-2.6	Orange-brown M-C SAND, trace silt.
				2.6-4	No Recovery.
8-12	4	1.8	NA	0-1.8	Orange-brown M-C SAND, trace silt, trace c-gravel.
				1.8-4	No Recovery.
12-16	4	2	NA	0-2	Orange-brown M-C SAND, some m-c gravel, trace silt. Wet at 14 fbg.
				2-4	No Recovery.

Lithology



Legend

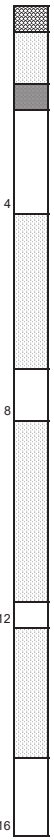
- Topsoil
- Sand
- No Recovery

Collect SS-01 (5-7)
Collect SS-01 (12-14)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-02
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2	NA	0-0.6	Gray ASH and M-C GRAVEL.
				0.6-1.2	Brown F-M SAND with some silty clay.
				1.2-2	Orange-brown SILTY CLAY with some f-m sand.
				2-4	No Recovery.
4-8	4	3	NA	0-0.8	Orange-brown F-M SAND, some clay.
				0.8-3	Orange-brown F-M SAND, trace silt, trace f-m gravel.
				3-4	No Recovery.
8-12	4	3.3	NA	0-3.3	Orange-brown M-C SAND, trace f-m gravel.
				3.3-4	No Recovery.
12-16	4	2.7	NA	0-2.7	Orange-brown M-C SAND, trace f-gravel, trace silt. Wet at 15.5-16 fbg.
				2.7-4	No Recovery,

Lithology



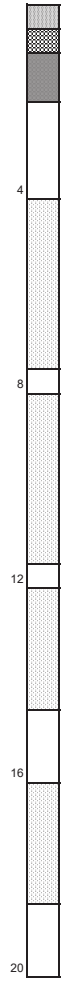
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- No Recovery

Collect SS-02 (1-3)
Collect SS-02 (14-16)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring: SS-03
Project Number: 171441.000050.000000	Drillers: Michael	Date Started: 10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed: 10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT	

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	2	NA	0-0.4	Gray-brown F-M SAND and SILT, some m-c gravel.	
				0.4-0.8	Light gray ASH with some m-c gravel, very moist.	
				0.8-2	Orange-brown SILTY CLAY, some f-m sand, trace f-gravel.	
				2-4	No Recovery.	
4-8	4	3.6	NA	0-3.6	Orange-brown F-M SAND, little silt, little f-gravel.	
				3.6-4	No Recovery.	
8-12	4	3.3	NA	0-2.7	Orange-brown F-M SAND, little silt, little f-gravel.	
				2.7-3.3	M-C SAND, trace silt, some m-c gravel.	
				3.3-4	No Recovery.	
12-16	4	2.5	NA	0-2.5	Orange-brown M-C SAND, trace silt, trace f-gravel, wet at 15.5-16 fbg.	
				2.5-4	No Recovery.	
16-20	4	2.5	NA	0-2.5	Orange-brown M-C SAND, little f-m gravel, wet.	
				2.5-4	No Recovery.	



Legend

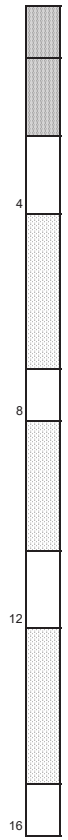
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-03 (0-2)
Collect SS-03 (13-15)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-04
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.6	NA	0-1	Brown VF-M SAND and SILT, little m-c gravel.
				1-2.6	Orange-brown F-M SAND and SILT, trace clay, little f-m gravel.
				2.6-4	No Recovery.
4-8	4	3	NA	0-3	Orange-brown F-M SAND, some silt, little f-m gravel.
				3-4	No Recovery.
8-12	4	2.7	NA	0-2.7	Orange-brown M-C SAND, trace silt, little f-m gravel.
				2.7-4	No Recovery.
12-16	4	2.9	NA	0-2.9	Orange-brown M-C SAND, trace silt, little f-m gravel, wet at 15-16 fbg.
				2.9-4	No Recovery.

Lithology



Legend

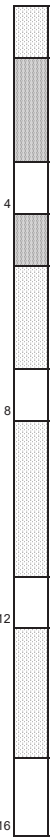
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-04 (2-4)
Collect SS-03 (14-16)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-05
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.9	NA	0-1	Brown F-M SAND, some silt, some m-c gravel.
				1-2.9	Orange-brown F-M SAND and SILT, trace clay, trace f-m gravel.
				2.9-4	No Recovery.
4-8	4	3	NA	0-1	Orange-brown F-M SAND and SILT, trace f-m gravel.
				1-3	Orange-brown F-C SAND, trace f-m gravel.
				3-4	No Recovery.
8-12	4	3	NA	0-1.5	Orange-brown F-C SAND, trace-silt, trace f-m gravel.
				1.5-3	Orange-brown M-C SAND, trace f-c gravel.
				3-4	No Recovery.
12-16	4	2.3	NA	0-2.3	Orange-brown M-C SAND, trace f-c gravel, wet at 15.5-16 fbg.
				2.3-4	No Recovery.

Lithology



Legend

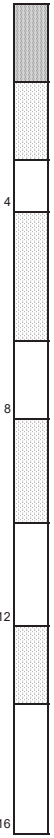
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-05 (5-7)
Collect SS-05 (13-15)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-06
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.9	NA	0-0.6	Gray-brown VF-FSAND and SILT, trace f-m gravel.
				0.6-1	Brown F-M SAND and SILT, trace f-m gravel.
				1-1.5	Orange-brown F-M SAND and SILT, trace clay, trace f-m gravel.
				1.5-2.9	Orange-brown F-M SAND, little silt.
				2.9-4	No Recovery.
4-8	4	2.5	NA	0-2.5	Orange-brown F-M SAND, trace silt, little m-c gravel.
				2.5-4	No Recovery,
8-12	4	2.2	NA	0-2.2	Orange-brown F-C SAND, little m-c gravel.
				2.2-4	No Recovery.
12-16	4	1.6	NA	0-1.6	Orange-brown F-C SAND, little m-c gravel, wet at 15.5-16 fbg.
				1.6-4	No Recovery.

Lithology



Legend

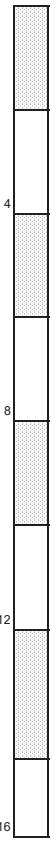
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-06 (1-3)
Collect SS-06 (14-16)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-07
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.1	NA	0-1	Dark brown F-M SAND, little silt, some m-c gravel.
				1-2.1	Orange-brown F-M SILTY SAND, little clay.
				2.1-4	No Recovery.
4-8	4	2.2	NA	0-0.5	Orange-brown F-M SILTY SAND, little clay.
				0.5-2.2	Orange-brown F-M SAND, little f-m gravel.
				2.2-4	No Recovery.
8-12	4	2.3	NA	0-1	Orange-brown F-M SAND, little f-m gravel.
				1-2.3	Orange-brown M-C SAND, little f-m gravel.
				2.3-4	No Recovery.
12-16	4	2.5	NA	0-2.5	Orange-brown M-C SAND, little f-m gravel. Wet at 15.5-16 fbg.
				2.5-5	No Recovery.

Lithology



Legend

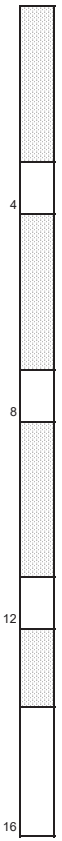
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-07 (6-8)
Collect SS-07 (13-15)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-08
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Near former storage shed	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	3	NA	0-0.2	Dark brown F-M SAND, little m-c gravel.
				0.2-3	Orange-brown F-M SAND, some silt, trace clay, trace f-m gravel.
				3-4	No Recovery.
4-8	4	2.9	NA	0-2.9	Orange-brown F-M SAND, little silt, trace f-m gravel.
				2.9-4	No Recovery.
8-12	4	2.8	NA	0-2.8	Orange-brown F-M SAND, trace silt, trace f-gravel.
				2.8-4	No Recovery.
12-16	4	2.5	NA	0-1	Orange-brown F-M SAND, trace silt, trace f-gravel.
				1-2.5	Orange-brown M-C SAND, trace f-m gravel, wet at 15.5-16 fbg.
				2.5-4	No Recovery.

Lithology



Legend

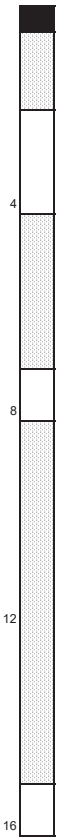
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-08 (3-4)
Collect SS-08 (12-14)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-09
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	1.9	NA	0-0.5	TOPSOIL.
				0.5-1.9	Orange-brown F-C SAND, some silt, trace clay, some f-c gravel, very moist.
				1.9-4	No Recovery.
4-8	4	3.3	NA	0-3.3	Orange-brown F-M SAND, little silt, trace clay, little f-m gravel, very moist near bottom.
				3.3-4	No Recovery.
8-12	4	3.8	NA	0-1	Orange-brown F-M SAND, little silt, trace clay, little f-m gravel
				1-3.8	Orange-brown F-C SAND, little silt, trace f-m gravel.
				3.8-4	No Recovery.
12-16	4	3.1	NA	0-2	Orange-brown F-C SAND, trace silt, trace f-m gravel.
				2-3.1	Red-brown F-C SAND, trace f-m gravel, wet at 14-16 fbg.
				3.1-4	No Recovery.

Lithology



Legend

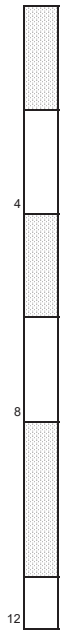
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-09 (6-8)
Collect SS-09 (12-14)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-10
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/26/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/26/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2	NA	0-1	Brown F-M SAND, some silt, little f-m gravel.
				1-2	Orange-brown F-M SAND, some silt, little f-m gravel.
				2-4	No Recovery.
4-8	4	2.2	NA	0-1	Orange-brown M-C SAND.
				1-2.2	F-M SAND, some silt, trace f-m gravel, wet at tip.
				2.2-4	No Recovery.
8-12	4	3.2	NA	0-3.2	Orange-brown F-C SAND, trace f-m gravel, wet.
				3.2-4	No Recovery.

Lithology



Legend

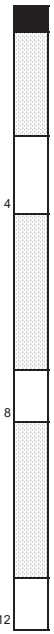
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-10 (2-4)
Collect SS-10 (4-6)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-11
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.6	NA	0-0.4	TOPSOIL
				0.4-2.6	Orange-brown F-M SAND, some silt, little clay, trace f-m gravel.
				2.6-4	No Recovery.
4-8	4	2.8	NA	0-1	Orange-brown F-M SAND, some silt, little clay, trace f-m gravel.
				1-2	Orange-brown M-C SAND, trace silt, little f-m gravel.
				2-2.8	Tan F-M SAND.
				2.8-4	No Recovery.
8-12	4	3	NA	0-0.5	Tan F-M SAND.
				0.5-3	Orange-brown F-M SAND, some silt, trace clay, trace f-m gravel. Wet at 8-12 fbg.
				3-4	No Recovery.

Lithology



Legend

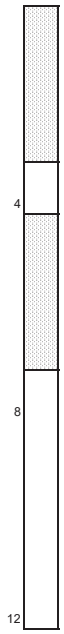
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-11 (1-3)
Collect SS-11 (5-7)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-12
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	3	NA	0-1	Brown F-M SAND, little silt, trace f-m gravel.
				1-3	Orange-brown F-M SAND, little silt, little f-m gravel.
				3-4	No Recovery.
4-8	4	3	NA	0-0.5	Orange-brown F-M SAND, little silt, little f-m gravel.
				0.5-2.2	Orange-brown M-C SAND, little f-m gravel.
				2.2-3	Orange-brown F-M SAND, some silt, little clay. Wet at tip.
				3-4	No Recovery.
8-12	4	0	NA	0-4	No Recovery. Sleeve jammed inside macro-core. Wet.

Lithology



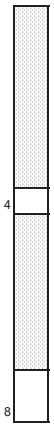
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-12 (2-4)
Collect SS-12 (5-7)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-13
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	3.4	NA	0-1.2	Brown F-M SAND, little silt, little f-m gravel.	
				1.2-3.4	Orange-brown F-M SAND, little silt, little f-m gravel.	
				3.4-4	No Recovery.	
4-8	4	2.9	NA	0-1.9	Orange-brown F-M SAND, little silt, little f-m gravel.	
				1.9-2.9	Orange-brown m-c sand, little f-m gravel. Wet at bottom 0.2'	
				2.9-4	No Recovery.	



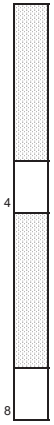
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-13 (1-3)
Collect SS-13 (5-7)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-14
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	3	NA	0-3	Brown F-M SAND, little silt, little f-m gravel.	
				3-4	No Recovery.	
4-8	4	3	NA	0-1	Brown F-M SAND, little silt, little f-m gravel.	
				1-3	Red brown M-C SAND, trace f-m gravel. Wet at bottom 0.2'	
				3-4	No Recovery.	



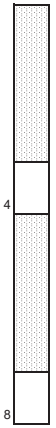
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-14 (1-3)
Collect SS-14 (6-8)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-15
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	2.9	NA	0-1	Brown F-M SAND, little silt, little f-c gravel.	
				1-1.1	C-GRAVEL.	
				1.1-2.9	Orange-brown F-C SAND, little f-m gravel.	
				2.9-4	No Recovery.	
4-8	4	3.5	NA	0-0.5	Orange-brown F-C SAND, little f-m gravel.	
				0.5-1.9	Orange-brown F-M SILTY SAND, some clay.	
				1.9-3.5	Orange-brown F-M SAND, little silt. Wet at bottom 0.1'	
				3.5-4	No Recovery.	



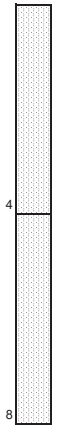
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-15 (2-4)
Collect SS-15 (4-6)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-16
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	4	NA	0-0.8	Dk. Brown F-M SAND, little silt	
				0.8-2.1	Brown F-M SAND, little silt, some f-c gravel.	
				2.1-4	Orange-brown F-M SAND, some silt, trace clay, little f-c gravel.	
4-8	4	4	NA	0-4	Orange-brown F-M SAND, some silt, trace clay. Wet at tip.	



Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

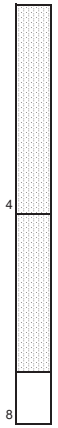
Collect SS-16 (1-3)
Collect SS-16 (6-8)

Project Name: SMC Off-Site Ground Water Investigation
Project Number: 171441.000050.000000
Project Location: Newfield, NJ
Boring Location: Former lagoons

Drilling Company: Unitech Drilling Co., Inc.
Drillers: Michael
TRC Inspector: John Moss
Drill Equipment / Method: Geoprobe 66DT

Boring: SS-17
Date Started: 10/27/09
Date Completed: 10/27/09

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	4	NA	0-2.5	Brown F-M SAND, little silt, little f-c gravel.	
				2.5-4	Orange-brown F-M SAND, some silt, little clay, little f-m gravel.	
4-8	4	3	NA	0-3	Orange-brown F-M SAND, some silt, little clay, little f-m gravel. Wet at bottom 0.5'	
				3-4	No Recovery.	



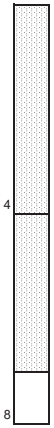
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-17 (1-3)
Collect SS-17 (5-7)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-18
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	4	NA	0-1.3	Dk. Brown F-M SAND, little silt, trace clay, trace f-m gravel.	
				1.3-4	Brown F-M SAND, some silt, little clay, trace f-c gravel.	
4-8	4	3	NA	0-0.5	Brown F-M SAND, some silt, little clay, trace f-c gravel.	
				2.5-3	Orange-brawn M-C SAND, little f-m gravel, red at bottom. Wet at bottom 0.2'	
				3-4	No Recovery.	



Legend

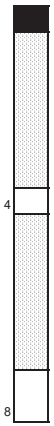
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-18 (1-3)
Collect SS-18 (6-8)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-19
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	3.5	NA	0-0.5	Dk. Brown F-M SAND, some silt (TOPSOIL).
				0.5-1.5	Orange-brown F-M SAND, little f-m gravel, trace silt.
				1.5-1.7	Brown-black F-M SAND
				1.7-2.6	Brown F-M SAND, little sitl, little f-m gravel.
				2.6-3.5	Orange-brown F-C SAND, little f-c gravel.
				3.5-4	No Recovery.
4-8	4	3.3	NA	0-0.8	Orange-brown F-M SAND, little silt, little clay
				0.8-3.3	Orange-brown m-c sand,some m-c Wet at bottom 0.5'
				3.3-4	No Recovery.

Lithology



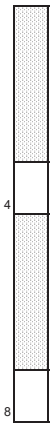
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-19 (1-3)
Collect SS-19 (6-8)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-20
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/27/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/27/09
Boring Location: Former lagoons	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	3.2	NA	0-2.4	Brown F-M SAND, trace silt. Little f-m gravel.	
				2.4-2.6	Dense orange-brown F-SILTY SAND gravel, trace silt.	
				2.6-3.2	Brown F-M SAND, some f-m gravel.	
				3.2-4	No recovery.	
4-8	4	3.2	NA	0-3.2	Brown F-M SAND, trace silt, little f-m gravel. Wet at tip.	
				3.2-4	No Recovery.	



Legend

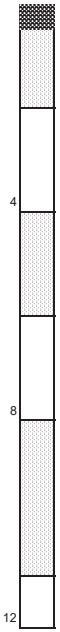
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-20 (1-3)
Collect SS-20 (4-6)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-21
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/28/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/28/09
Boring Location: Former Bldg. D102 footprint	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	1.4	NA	0-0.5	Concrete
				0.5-1	Brown F-M SAND, little f-m gravel.
				1-1.9	Orange-brown M-C SAND, little f-m gravel.
				1.9-4	No Recovery.
4-8	4	2.3	NA	0-2.3	Orange-brown M-C SAND, little m-c gravel. Wet at tip.
				2.3-4	No Recovery.
8-12	4	3	NA	0-1	Orange-brown F-M SAND, some silt, trace f-m gravel. Wet.
				1-3	Orange-brown F-M SAND. Wet.
				3-4	No Recovery.

Lithology



Legend

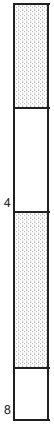
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- Concrete
- No Recovery

Collect SS-21 (1-3)
Collect SS-21 (5-7)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-22
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/28/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/28/09
Boring Location: Former Bldg. D102 footprint	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.1	NA	0-0.6	Brown F-M SAND, some f-m gravel, little silt.
				0.6-0.9	Orange-brown F-M SAND.
				0.9-1.2	Black F-M SAND, petro odor.
				1.2-2.1	Brown F-M SAND, little silt, little f-m gravel.
				2.1-4	No recovery.
4-8	4	3.1	NA	0-0.6	Brown F-M SAND, little silt, little f-m gravel.
				0.6-3.1	Orange-brown M-C SAND, little f-m gravel. Wet at tip.
				3.1-4	No recovery.

Lithology



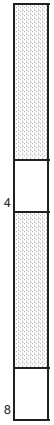
Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-22 (1-3)
Collect SS-22 (6-8)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-23
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/28/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/28/09
Boring Location: Former Bldg. D102 footprint	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description	Lithology
0-4	4	2.9	NA	0-0.6	Brown F-M SAND, some m-c gravel and concrete fragments.	
				0.6-1.6	Orange-brown F-M SAND, little f-m gravel.	
				1.6-2.9	Dk. Brown F-M SAND, little silt.	
				2.9-4	No recovery.	
4-8	4	3.3	NA	0-0.6	Orange-brown M-C SAND, little f-m gravel. Wet at tip.	
				3.3-4	No recovery.	



Legend

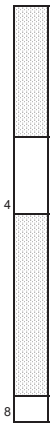
- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-23 (2-4)
Collect SS-23 (6-8)

Project Name: SMC Off-Site Ground Water Investigation	Drilling Company: Unitech Drilling Co., Inc.	Boring:	SS-24
Project Number: 171441.000050.000000	Drillers: Michael	Date Started:	10/28/09
Project Location: Newfield, NJ	TRC Inspector: John Moss	Date Completed:	10/28/09
Boring Location: Former Bldg. D102 footprint	Drill Equipment / Method: Geoprobe 66DT		

Depth (feet)	Penetration (ft)	Recovery (ft)	PID (ppm)	(ft)	Soil Description
0-4	4	2.5	NA	0-0.9	Black-Brown F-M SAND, little c-sand, some f-c gravel and concrete fragments.
				0.9-1.6	Orange-brown F-M SAND, little f-m gravel.
				1.6-1.8	Black gravel.
				1.8-2.5	Brown F-M SAND, little f-m gravel.
				2.5-4	No recovery.
4-8	4	3.3	NA	0-1.4	Brown F-M SAND, little f-m gravel.
				1.4-3.3	Orange-Brown F-M SAND, some silt, little clay. Wet at tip.
				3.3-4	No recovery.

Lithology



Legend

- Topsoil
- Sand
- Silty Clay
- Gravel
- Sand and Silt
- Ash
- No Recovery

Collect SS-24 (1-3)
Collect SS-24 (4-6)

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: Whale pump
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13 (25-30')
Date: 10/14/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 11:05

Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
11:10				4.62	0.138	986.1	8.02	12.97		242.0	Orange-brown, silty
11:14				4.42	0.141	614.8	8.13	12.93		267.0	Orange-brown, silty
11:17				4.34	0.144	461.0	8.23	12.90		281.9	Orange-brown, silty
11:21				4.32	0.147	321.0	8.30	12.88		288.8	Orange-brown, silty
11:26				4.33	0.150	219.3	8.40	12.85		295.6	Orange-brown, silty
11:30				4.30	0.152	128.2	8.47	12.85		297.4	Orange-brown, silty
11:35				4.31	0.153	57.3	8.59	12.82		302.3	Clear
3@3-5 m.			30-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13 (25-30') Sample Time: 11:35 TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13 (50-55')
Date: 10/14/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 13:14 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
13:17				5.18	0.171	1086.4	2.97	14.09		208.5	Orange-brown, silty
13:20				4.78	0.174	1035.5	3.11	13.96		227.1	Orange-brown, silty
13:23				4.62	0.175	506.4	2.69	13.82		245.5	Orange-brown, silty
13:26				4.60	0.174	284.8	2.44	13.67		252.8	Orange-brown, silty, clearing
13:29				4.62	0.176	177.0	2.35	13.63		257.8	Orange-brown, silty, clearing
13:32				4.61	0.176	97.7	2.28	13.57		266.9	Orange-brown, silty, clearing
13:37				4.62	0.176	59.5	2.28	13.52		269.4	Slightly cloudy
13:45				4.65	0.175	46.9	2.17	13.44		277.6	Slightly cloudy
3@3-5 m.			~100-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13 (50-55') — Sample Time: 13:45 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13 (75-80')
Date: 10/14/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 14:40 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
14:43				4.48	0.131	408.0	6.41	14.19		245.7	Slight orange-brown, silty
14:48				4.46	0.125	26.8	7.36	14.20		269.8	clear
14:53				4.41	0.125	8.2	7.50	14.16		287.0	clear
3@3-5 m.			~70-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13 (75-80') — Sample Time: 14:55 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13 (100-105')
Date: 10/15/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 8:28 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
8:31				5.70	0.148	1109.7	3.18	13.81		96.2	Orange-brown, silty
8:36				5.34	0.122	321.4	6.61	14.09		153.7	Orange-brown, silty
8:41				5.14	0.117	528.5	7.62	14.18		183.2	Orange-brown, silty
8:46				5.02	0.115	328.5	7.87	14.21		200.6	Orange-brown, silty
8:51				4.88	0.113	274.6	8.05	14.00		218.4	Orange-brown, silty
8:56				4.77	0.113	166.7	8.13	13.98		232.0	Orange-brown, silty
9:01				4.74	0.113	99.4	8.16	13.98		240.4	Slightly cloudy
9:06				4.71	0.113	54.3	8.18	13.99		247.0	Slightly cloudy
9:11				4.68	0.113	35.4	8.20	13.99		252.4	Clear
3@3-5 m.			~100-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13 (100-105') — Sample Time: 9:15 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13 (125-130')
Date: 10/15/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 10:32

Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
10:37				6.22	0.039	1113.1	8.08	14.18		208.6	Orange-brown, silty
10:42				5.13	0.035	718.5	8.50	14.19		223.3	Orange-brown, silty
10:45 - 10:49	Not pumping										
10:52				5.14	0.034	1085.0	8.39	14.17		222.7	Orange-brown, silty
10:56 - 11:22	Not pumping										
11:25				5.22	0.034	500.8	8.24	14.10		213.2	Orange-brown, silty
11:30				5.13	0.033	116.9	8.40	14.14		226.8	Slightly cloudy
11:34				5.09	0.033	50.1	8.42	14.15		231.9	Clear
11:38				5.05	0.033	15.1	8.44	14.16		235.6	Clear
3@3-5 m.			~100-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13 (125-130') — Sample Time: 11:40 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~50-degrees, cloudy
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: Vp-13A (15-20')
Date: 10/22/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 11:58 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
12:04				4.63	0.387	1414.6	1.59	18.43		192.8	Orange-brown, silty
12:07 - 12:09	Not Pumping										
12:13				4.72	0.436	1420.2	0.86	18.90		199.1	Orange-brown, silty
12:15				4.68	0.447	1065.2	0.62	18.86		205.0	Orange-brown, silty
12:20				4.67	0.454	290.1	0.58	18.91		208.1	Cloudy
12:24				4.69	0.458	197.5	0.47	19.00		208.1	Slightly Cloudy
12:28				4.71	0.460	107.3	0.47	19.10		206.3	Clear
12:35				4.73	0.462	44.2	0.43	19.17		205.2	Clear
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13A (15-20') — Sample Time: 12:35 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~60-degrees, sunny
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13A (37-42')
Date: 10/22/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 14:03 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
14:06				4.52	0.186	181.6	0.40	14.75		154.9	Slightly orange-brown, silty
14:11				4.44	0.183	42.7	0.25	14.56		197.4	Clear
14:14				4.42	0.182	32.8	0.23	14.50		213.9	Clear
3@3-5 m.			~80-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13A (37-42') — Sample Time: 14:15 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13A (62-67')
Date: 10/22/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 15:06 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
15:13				4.62	0.148	1215.2	0.29	16.44		174.7	Orange-brown, silty
15:50				4.80	NA	3.7	NA	NA		NA	Clear
3@3-5 m.			~70-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13A (62-67') — Sample Time: 15:50 — TRC Personnel: J. Moss

Analysis	Containers: Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~55-degrees, cloudy
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13A (87-92')
Date: 10/23/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 8:28 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
8:31				5.65	0.115	471.2	3.02	14.37		52.7	Orange-brown, silty
8:35				4.84	0.100	95.1	5.31	14.27		127.4	Clear
8:38				4.76	0.100	107.7	5.30	14.25		145.3	Clear
8:41				4.67	0.100	55.7	6.20	14.22		161.6	Clear
8:46				4.61	0.100	42.4	6.25	14.21		181.5	Clear
8:50				4.56	0.100	27.8	6.62	1.20		197.3	Clear
8:52				4.55	0.100	26.3	6.60	14.19		201.2	Clear
3@3-5 m.			~125-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13A (87-92') — Sample Time: 8:55 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~60-degrees, cloudy
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-13A (111-116')
Date: 10/26/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 9:57 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
10:00				5.27	0.058	1374.0	5.41	14.64		133.5	Orange-brown, silty
10:06				4.87	0.039	138.7	7.47	14.60		181.1	Cloudy
10:11				4.85	0.038	38.9	7.62	14.54		191.6	Clear
10:15				4.87	0.037	18.5	7.67	14.50		198.2	Clear
10:17				4.88	0.037	15.1	7.70	14.49		200.7	Clear
3@3-5 m.			~75-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-13A (111-116') — Sample Time: 10:20 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: Whale pump
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-14 (35-40')
Date: 10/16/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 12:00 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
12:27				5.20	0.188	1109.0	4.55	13.64		234.8	Orange-brown, silty
12:32				4.90	0.181	1074.6	5.48	14.30		232.5	Orange-brown, silty
12:40				4.76	0.215	581.0	3.16	14.81		224.4	Orange-brown, silty
12:45				4.73	0.228	487.7	2.97	14.84		215.0	Orange-brown, silty
12:49				4.73	0.237	530.0	2.90	14.85		208.9	Orange-brown, silty
12:53				4.73	0.242	408.8	2.90	14.90		197.5	Orange-brown, silty
13:00				4.74	0.248	254.6	2.91	14.94		189.6	Cloudy
13:06				4.76	0.252	180.0	2.87	14.94		177.5	Slightly cloudy
3@3-5 m.			~75-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-14 (35-40') — Sample Time: 13:10 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-14 (55-60')
Date: 10/16/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 13:50 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
13:53				4.75	0.090	487.4	7.46	14.23		249.3	Cloudy, orange-brown silt
13:57				4.70	0.087	182.2	7.56	14.70		246.3	Cloudy
14:03				4.67	0.086	52.3	7.73	14.83		249.5	Clear
14:06				4.65	0.085	43.7	7.82	14.80		253.3	Clear
14:09				4.62	0.084	46.0	7.94	14.60		256.3	Clear
14:13				4.60	0.085	36.4	8.01	14.59		260.9	Clear
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-14 (55-60') — Sample Time: 14:15 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-14 (130-135')
Date: 10/19/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 14:40 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
14:51				4.77	0.065	209.8	3.73	14.39		207.6	Cloudy, orange-brown silt
14:56				4.70	0.063	99.0	3.72	14.36		228.3	Slightly cloudy
14:58				4.68	0.062	77.3	3.71	14.35		235.5	Clear
15:01				4.66	0.062	64.6	3.70	14.36		242.0	Clear
15:05				4.60	0.061	58.3	3.68	14.32		249.5	Clear
15:07				4.60	0.061	55.0	3.67	14.32		251.6	Clear
3@3-5 m.			~100-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-14 (130-135') — Sample Time: 15:10 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15 (30-35')
Date: 10/12/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 14:03 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
14:15				8.60	0.124	1147.2	19.15	18.16		146.0	Yellow-brown, silty
14:24				5.87	0.129	1007.1	9.53	18.96		194.8	Yellow-brown, silty
14:28				5.27	0.121	135.2	8.51	18.01		229.8	Pale yellow
14:31				5.06	0.120	75.6	8.56	17.97		243.3	Pale yellow
14:34				4.94	0.119	48.7	8.53	17.94		254.2	Pale yellow
3@3-5 m.			~75-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15 (30-35') — Sample Time: 14:40 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15 (45-50')
Date: 10/12/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 15:26 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
15:29				4.96	0.074	284.0	2.80	17.31		240.3	
15:31				4.89	0.072	114.1	2.79	17.21		245.2	
15:34				4.83	0.071	33.3	2.79	17.10		256.7	
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15 (45-50') — Sample Time: 15:35 — TRC Personnel: J. Moss

Analysis	Containers: Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15 (65-70)
Date: 10/13/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 9:00 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
9:05				5.07	0.073	82.5	4.54	16.48		202.2	Yellow, silty, then clearing
9:08				4.94	0.072	29.8	4.78	16.43		215.9	Slightly yellow, silty
9:11				4.82	0.072	18.1	4.85	16.40		232.0	Clear
9:14				4.72	0.072	9.6	4.87	16.38		246.3	Clear
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15 (65-70') — Sample Time: 9:15 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15 (88-93')
Date: 10/13/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 10:24 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
10:26				5.11	0.066	1129.0	4.52	16.13		210.8	Yellow-brown, silty
10:29				4.90	0.062	317.8	5.03	15.76		234.5	Yellow-brown, silty
10:31				4.77	0.061	141.8	5.31	15.59		250.5	Yellow-brown, silty, clearing
10:34				4.66	0.059	72.9	5.40	15.46		265.3	Slightly silty
10:38				4.61	0.059	42.4	5.64	15.35		281.1	Slightly silty
3@3-5 m.			~100-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15 (88-93') — Sample Time: 10:40 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15 (114-119')
Date: 10/13/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 11:50 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
11:54				4.50	0.037	1112.3	0.50	17.05		100.0	Gray, silty
11:58				4.30	0.033	668.2	0.41	17.04		97.8	Gray, silty
12:02				4.19	0.034	225.3	0.36	17.00		104.1	Gray, silty
12:05				4.14	0.036	92.1	0.36	16.93		104.9	Gray, slightly silty
12:08				4.13	0.036	55.4	0.35	16.88		106.4	Gray, slightly silty
12:13				4.15	0.036	65.2	0.32	16.83		107.7	Gray, slightly silty
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15 (114-119') — Sample Time: 12:15 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: Whale pump
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15A (15-20')
Date: 10/20/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 15:05 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
15:09				5.73	0.554	165.3	5.92	17.48		122.1	Orange-brown, silty, slightly cloudy
15:14				5.64	0.560	118.1	6.01	17.44		119.7	Orange-brown, silty, slightly cloudy
15:18				5.62	0.564	85.2	5.94	17.42		112.7	Orange-brown, silty, slightly cloudy
15:23				5.60	0.525	265.4	5.62	17.37		114.5	Orange-brown, silty
15:28				5.59	0.554	112.0	5.63	17.34		128.5	Slightly cloudy
15:31				5.58	0.524	55.7	5.64	17.29		132.9	Clear
15:39				5.56	0.518	34.1	5.77	17.28		131.0	Clear
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15A (15-20') — Sample Time: 15:40 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~55-degrees, sunny
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15A (38-43')
Date: 10/21/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 8:36 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
8:39				4.98	0.084	656.3	3.92	13.99		148.9	Orange-brown, silty
8:42				4.85	0.084	92.5	3.88	14.48		181.8	Clear
8:45				4.80	0.084	79.1	3.92	14.50		196.8	Clear
8:50				4.75	0.084	44.6	4.01	14.53		214.3	Clear
3@3-5 m.			~100-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15A (38-43') — Sample Time: 8:50 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~60-degrees, sunny
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15A (55-60')
Date: 10/21/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 9:45 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
9:48				4.58	0.051	1377.4	3.84	15.01		199.9	Orange-brown, silty
9:53				4.49	0.050	220.7	4.14	14.62		237.7	Cloudy
10:20				4.52	0.049	43.0	4.20	14.44		268.5	Clear
3@3-5 m.			~125-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15A (55-60') — Sample Time: 10:20 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather:
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15A (77-82')
Date: 10/21/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 11:16 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
11:18				4.91	0.050	209.3	4.72	15.24		188.0	Orange-brown, silty
11:21				4.52	0.047	79.0	5.62	14.82		230.9	Orange-brown, slightly silty
11:25				4.37	0.047	62.0	5.86	14.59		255.3	Slightly cloudy, then clear
11:27				4.39	0.046	90.0	5.72	14.83		261.1	Clear
3@3-5 m.			~50-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15A (77-82') — Sample Time: 11:30 — TRC Personnel: J. Moss

Analysis	Containers: Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Ground Water Sampling Log

Client: SMC
Project Number: 112434.00GWAT.002235
Site Name / Location: SMC / Newfield / Off-site locations in Vineland
Site Conditions / Weather: ~65-degrees, sunny
Purge Method: SAT & submersible pump / packer assembly
Purge Equipment/Material: SAT
Headspace PID/FID (ppm): NA
Pump Intake (ftbtoc):

Well Identification: VP-15A (99-104')
Date: 10/21/2009
Depth to Water (ftbtoc): NA
Depth to Bottom (ftbtoc): NA
Standing Column (ft): NA
Well Diameter (in): 4.25"
Standing Volume (gal,liter): NA
Screened Interval (ftbtoc):

Purging Information — Start purge at: 13:40 — Well Casing Volumes: 1" = 0.04 gal/ft = 0.15 L/ft, 2" = 0.16 gal/ft = 0.62 L/ft, 4" = 0.65 gal/ft = 2.47 L/ft, 6" = 1.47 gal/ft = 5.56 L/ft

Time	DTW (ftbtoc)	Purge Rate (gpm,lpm)	Volume Purged (gal,liter)	pH	Specific Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (ºC)	Other	ORP (mV)	Comments / Observations (color, odor, etc.)
13:44				4.21	0.056	1380.3	5.53	15.31		199.2	Orange-brown, silty
13:47				3.73	0.055	72.4	6.38	14.82		248.3	Cloudy
13:50				3.68	0.055	22.0	6.51	14.56		261.6	Clear
13:54				3.67	0.054	9.2	6.60	14.37		271.6	Clear
3@3-5 m.			~110-gal	+/- 0.1	3%	10%	10%	3%		+/- 10 mV	

Sampling Information — Sample Identity: VP-15A (99-104') — Sample Time: 13:55 — TRC Personnel: J. Moss

Analysis	Containers Number	Size	Type	Preservative	Sampling Method/Material	Comments / Observations
VOCs						
Total Cr						
Cr+6						
Perchlorate						
Methane						
Nitrate						
Fe+2						

Supplemental Offsite Groundwater Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

SOIL BORING / MONITORING WELL CONSTRUCTION LOG

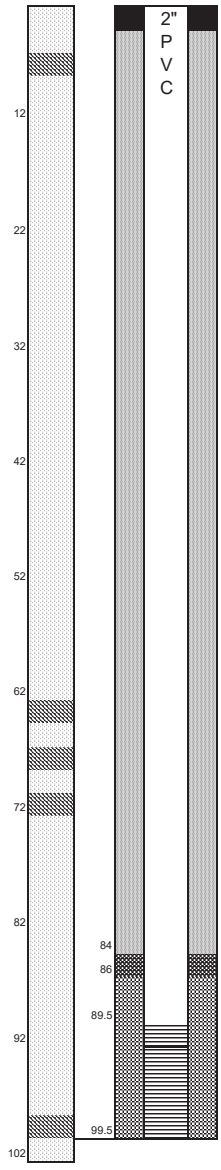
Project Name: SMC Offsite Ground Water Investigation
Project Number: 112434-00GWAT-002235
Project Location: Vineland, New Jersey
Boring Location: West Garden Road

Drilling Company: Unitech Drilling Co., Inc.
Drillers: Dan Evans and Joe Evans
TRC Inspector: Paul Cyr
Drill Equipment / Method: 1500 Midway Truck Rig
Mud Rotary / Pressure Tremie

Boring: SC-35D
Date Started: 10/29/2009
Date Completed: 10/29/2009
Depth to Water: NA
Horizontal Coordinates: E335051.78, N251029.52 (VP-15A)
Ground Elevation: NA
Inner Casing Elevation: NA

Depth (ftbgs)	Recovery/ Penetration (inches)	Split Spoon (inches)	Blow Counts	Soil Description
10-12	20/24	6	10	Light brown F SAND, trace M Sand
		12	14	and M Gravel
		18	15	Gray CLAY, trace C Gravel
		24	17	
20-22	8/18	6	25	Light brown F-M SAND, trace C
		12	30	Gravel
		18	50/5"	Spoon refusal at 21.5-ftbgs.
30-32	12/18	6	30	Light brown/orange F-M SAND,
		12	35	trace C Sand, trace F-M gravel
		18	50-5"	Spoon refusal at 31.5-ftbgs.
40-42	11/24	6	10	Red/orange/brown M-C SAND,
		12	15	little M-C Gravel, trace F sand
		18	19	and F gravel
		24	17	
50-52	20/20	6	24	Dark red/brown F SAND
		12	36	C GRAVEL, trace M Gravel
		18	50/7"	Spoon refusal at 51.7-ftbgs.
60-62	11/24	6	14	Gray CLAY and inter-bedded
		12	10	red/brown F SAND
		18	22	
		24	24	
70-72	9.5/18	6	10	Light brown F SAND, inter-bedded
		12	31	thin Clay layers
		18	50/5"	Red-brown F SAND, inter-bedded thin Clay layers
				Spoon refusal at 71.5-ftbgs.
80-82	11/24	6	15	Light brown F SAND, inter-bedded
		12	25	thin Silt layers
		18	36	
		24	40	
90-92	12/24	6	9	Light brown F SAND, trace C
		12	8	Gravel
		18	18	
		24	22	
100-102	19/24	6	10	Light brown F SAND, inter-bedded
		12	11	thin Clay layers
		18	13	
		24	15	

Lithology / Monitoring Well Construction



Legend
- Sand
- Sand and Clay
- # 0 Well Sand
- # 00 Well Sand
- Grout
- Screen (10-slot PVC)
- Concrete Pad
- PVC Riser

WELL CONSTRUCTION:
- 10-Slot PVC Screen (2") = 99.5-89.5 ftbgs
- PVC Riser (2") = 89.5 ftbgs-grade
- # 0 Well Sand = 99.5-86 ftbgs
- #00 Well Sand = 86-84 ftbgs
- Grout (bentonite/cement mixture) = 84-2 ftbgs
- Native Backfill = 2-0.5 ftbgs
- Concrete Pad = 0.5-grade
- Monitoring well secured with a locking sanitary plug.
- Monitoring well completed with a flush-mounted curb box.

NOTES:
- ftbgs - feet below ground surface.
- NA - Data not available at time of reporting.
- Horizontal datum (New Jersey State Plane Coordinates, NAD 83).
- Samples collected for geological description every 10 feet using split spoon (140 lb hammer dropped 30").
- Monitoring well developed using whale pumps in series and using surge and pump technique.

Supplemental Offsite Groundwater Investigation
Shieldalloy Metallurgical Corporation
Newfield, New Jersey

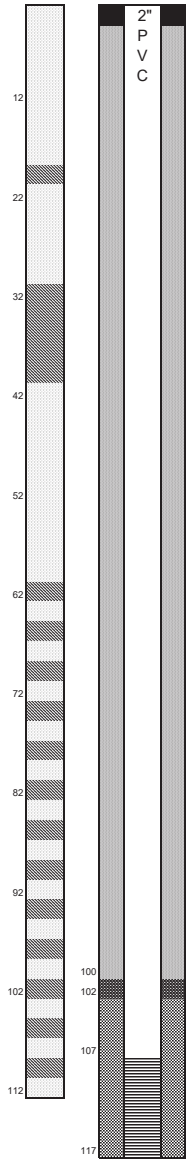
SOIL BORING / MONITORING WELL CONSTRUCTION LOG

Project Name: SMC Offsite Ground Water Investigation
Project Number: 112434-00GWAT-002235
Project Location: Vineland, New Jersey
Boring Location: Salem Avenue

Drilling Company: Unitech Drilling Co., Inc.
Drillers: Dan Evans and Joe Evans
TRC Inspector: Paul Cyr
Drill Equipment / Method: 1500 Midway Truck Rig
Mud Rotary / Pressure Tremie

Boring: SC-36D
Date Started: 11/3/2009
Date Completed: 11/4/2009
Depth to Water: NA
Horizontal Coordinates: E341283.30, N258484.52 (VP-13A)
Ground Elevation: NA
Inner Casing Elevation: NA

Depth (ftbgs)	Recovery/ Penetration (inches)	Split Spoon (inches)	Blow Counts	Soil Description
10-12	11/24	6	12	Red/orange/brown M-C SAND, trace
		12	16	C Gravel
		18	26	Red-brown M-C SAND
		24	29	Light brown - red-brown F SAND
20-22	8/24	6	16	Medium brown F SAND, thin Clay
		12	18	layer at 20-ftbgs.
		18	17	
		24	17	
30-32	24/24	6	22	Cobbles
		12	24	Red-brown F SAND
		18	17	Tan CLAY
		24	18	
40-42	15.5/24	6	20	Tan CLAY
		12	20	Red-brown F-M SAND
		18	29	
		24	37	
50-52	8/11	6	36	Red-brown M-C SAND, little M
		12	50/5"	Gravel, trace clay, trace C gravel
				Spoon refusal at 51-ftbgs.
60-62	23/24	6	13	Tan-medium brown CLAY, trace
		12	8	F Sand
		18	14	Medium brown F SAND
		24	20	Tan CLAY, trace F Sand
				Red-brown F SAND, trace clay
				Medium to light brown F SAND
70-72	19/24	6	8	Gray-brown CLAY and F SAND
		12	10	Medium brown F SAND, trace Clay
		18	7	Red-brown F SAND
		24	8	CLAY, trace F Sand
80-82	19/24	6	13	Tan CLAY
		12	7	Medium brown F SAND, trace Clay
		18	14	
		24	20	
90-92	14/24	6	16	Medium brown F SAND, trace Clay
		12	9	
		18	15	
		24	23	
100-102	18/24	6	13	Tan CLAY, trace M Gravel
		12	18	Red-brown F SAND, trace Clay
		18	26	
		24	26	
105-107	12/24	6	18	Cobbles, trace F Sand
		12	20	Tan CLAY, trace F Sand
		18	23	Red-brown F SAND, trace M Gravel,
		24	30	trace clay
110-112	12/24	6	9	Medium brown F SAND, trace Clay
		12	9	
		18	15	
		24	23	



Legend
- Sand
- Sand and Clay
- # 0 Well Sand
- # 00 Well Sand
- Grout
- Screen (10-slot PVC)
- Concrete Pad
- PVC Riser

WELL CONSTRUCTION:
- 10-Slot PVC Screen (2") = 117-107 ftbgs
- PVC Riser (2") = 107 ftbgs-grade
- # 0 Well Sand = 117-102 ftbgs
- #00 Well Sand = 102-100 ftbgs
- Grout (bentonite/cement mixture) = 100-1 ftbgs
- Native Backfill = 1-0.5 ftbgs
- Concrete Pad = 0.5-grade
- Monitoring well secured with a locking sanitary plug.
- Monitoring well completed with a flush-mounted curb box.

NOTES:
- ftbgs - feet below ground surface.
- NA - Data not available at time of reporting.
- Horizontal datum (New Jersey State Plane Coordinates, NAD 83).
- Samples collected for geological description every 10 feet using split spoon (140 lb hammer dropped 30").
- Monitoring well developed using whale pumps in series and using surge and pump technique.

TRC
Results you can rely on
21 Griffin Road North
Windsor, CT 06095
Telephone: 860-298-9692
Fax: 860-298-6399

BORING/WELL NUMBER: **SC40D**

PROJECT INFORMATION

Project Name:	**Perchlorate RI**
Project Location:	**Between 540 and 560 Salem Avenue, Vineland, NJ**
Project Number:	**177208.0000.000003**
Client:	**SMC**
TRC Eng./Geol:	**John Moss**
Checked By:	**Larry Butlien**

BORING/WELL INFORMATION

Boring Depth:	**142**	Hole Diameter:	**4.25**
Date Started:	**4/4/11**	Date Completed:	**4/5/11**
Coordinate System:	**New Jersey State Plane, NAD 83**		
North:	**258986**	East:	**342114**
Vertical Datum:	**NAVD88**	Ground Elevation:	**97**
Well Elevation (Top of Casing)	**96.91 ft.**		

DRILLING INFORMATION

Drilling Contractor:	**Uni-Tech Drilling**
Driller(s):	**Michael**
Drilling Method:	**Mud Rotary**
Equipment/Model:	**Failing 1500**
Sampler:	**2" split spoon**

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			**4/5/2011**
DEPTH (ft.bgs.)			**14.5**
REFERENCE			**Ground Surface**
STABILIZATION			

DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	PENETRATION (FT.)	RECOVERY (FT.)	BLOW COUNTS	LITHOLOGY	◆ VOC SCREENING RESULTS (ppm) 20 40 60 80	MATERIAL DESCRIPTION	WELL DIAGRAM
11	SS-1	X	2.0	1.5	14 20 22 23			Yellow-Brown Very Fine-Medium SAND, trace Gravel; thin band of Silty Sand at 10.5'	Flush-to-grade road box well protector
21	SS-2	X	2.0	1.3	20 36 34 36			Yellow-Brown Very Fine-Fine SAND; coarse Gravel at top of recovery	
31	SS-3	X	2.0	0.8	15 22 27 32			Yellow-Brown Very Fine-Coarse SAND; coarse Gravel at top of recovery	
41	SS-4	X	2.0	1.1	34 38 50 56			Yellow-Brown Very Fine-Coarse SAND, trace fine Gravel; coarse Gravel at top of recovery; thin Light Gray Clay lens at 41.5'	

SOIL BORING / WELL COMPLETION - TRC-STD US.GDT - 6/20/11 14:40 - H:\HAZMAT\SMC\NEWFIELD\PERCHLORATE\PERCHLORATE RI\ADDITIONAL WELL INSTALL - SC40D\SMC PERCHLORATE - SC40D.GPJ

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DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	PENETRATION (FT.)	RECOVERY (FT.)	BLOW COUNTS	LITHOLOGY	◆VOC SCREENING RESULTS (ppm) 20 40 60 80	MATERIAL DESCRIPTION	WELL DIAGRAM
46–50									
51	SS-5	X	1.4	0.8	45 50 50/5"			Yellow-Brown Very Fine-Medium SAND with some medium-coarse Gravel	
52–60								Brown Fine-Coarse SAND	Portland cement / bentonite grout mix
61	SS-6	X	2.0	0.8	32 32 30 26			Light Tan Very Fine-Medium SAND	
62–70								Red-Brown Very Fine-Coarse SAND; coarse Gravel at top of recovery	
71	SS-7	X	1.3	0.9	30 50 50/4"			Light Tan Fine-Medium SAND	
72–80									
81	SS-8	X	1.3	0.7	24 29 50/4"			Light Tan Very Fine-Fine SAND	
82–90								Yellow-Brown Very Fine-Fine SAND with trace Light Gray Clay lenses	
91	SS-9	X	0.9	0.6	30 50/5"			Tan Very Fine-Fine SAND	
92–95									

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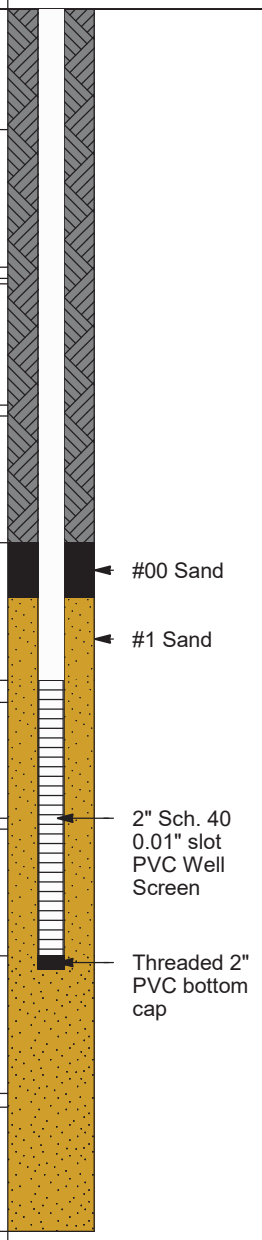
DEPTH (FT.)	SAMPLE NUMBER	SAMPLE TYPE	PENETRATION (FT.)	RECOVERY (FT.)	BLOW COUNTS	LITHOLOGY	◆VOC SCREENING RESULTS (ppm) (20 40 60 80)	MATERIAL DESCRIPTION
101	SS-10		0.4	0.4	50/5"			Yellow-Brown Very Fine-Medium SAND with little Light Gray Clay lenses
106	SS-11		0.9	0.6	24 50/5"			Yellow-Brown Very Fine-Medium SAND Yellow-Brown Very Fine-Medium SAND with little Light Gray Clay lenses and Dark Brown/Red-Brown lenses
111	SS-12		0.4	0.4	50/5"			Tan Very Fine-Medium SAND, some Light Gray Clay at top of recovery
116	SS-13		1.3	0.8	22 28 50/4"			Yellow-Brown Very Fine-Medium SAND, little medium Gravel
121	SS-14		2.0	0.8	20 24 30 57			Yellow-Brown Very Fine-Medium SAND, little Light Gray Clay and coarse Sand at top of recovery
126	SS-15		0.8	0.4	30 50/4"			Orange-Brown Fine-Coarse SAND
131	SS-16		2.0	0.8	20 26 46 50			Tan Very Fine-Fine SAND, little fine Gravel, little Light Gray Clay
136	SS-17		1.7	1.0	24 34 55 17/2"			Tan Fine-Coarse SAND, trace Light Gray Clay lenses Orange-Brown Very Fine-Fine SAND, some Light Gray Clay lenses
141	SS-18		2.0	1.0	16 21 31 23			Orange-Brown Very Fine-Medium SAND with some fine Gravel
143								Bottom of borehole at 142.0 feet.

WELL DIAGRAM



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